The Electrical World.

VOL. XXXIII NEW YORK, FEBRUARY 4, 1899. No. 5.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

in the United States, Canada or Mexico; other foreign countries, $6.00.

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXIII. NEW YORK, FEBRUARY 4, 1899. No. 5.

CONTENTS.

	PAGE.
Editorial	137
Latest Progress in the Application of Storage Batteries, by Joseph Appleton.	139
Inductive Loads (Arc Lamps and Motors) on Alternating Current Transformers, by Prof. D. C. Jackson	145
The Electrical Locomotive of the Paris, Lyons & Mediterranean Railway	146
The Open-Conduit Electric Railway in Paris	148
The Modern Single-Phase Alternating-Current Motor, by T. M. Meston	150
Digest of Current Electrical Literature, Compiled by Carl Hering	151
"Ideal" Alternator for Experimental Work	155
A Suspended Electric Fan	156
A Generator of Interrupted Currents	156
Departments:	
Financial Intelligence	157
Special Correspondence	157
General News	160
Legal Notes	162
Personal Notes	163
Obituary Note	163
Trade and Industrial Notes	163
Illustrated Record of Electrical Patents	164

CONSOLIDATIONS IN THE ELECTRICAL INDUSTRIES.

One of the most striking features of the outburst—one might almost call it—of consolidations of the last year or two is the attention which has been devoted to companies whose work is founded on the electrical arts. Among the manufacturers of electrical apparatus, as well as companies operating telephone, central-station and street-railway systems, the promoter of syndicates has been at work with a success that stimulates and is in turn helped by the eagerness of the financial public to invest and speculate in electrical securities, which are now the most prominent industrials on the exchange or the curb.

It is not strange that this should be the case. The general movement is the outcome of the demand for production at the lowest possible cost, a feature always neglected in newly developing industries, where large profits are expected to compensate for great risks, but inevitable when the industry reaches a steady-going basis such as electrical construction is now approaching. In the manufacture of electrical goods the company operating on a large scale has the same advantage over smaller competitors that exists in other lines, and the growth of rivals is checked by that intended foe of all competition, the patent system, of which great use is naturally made in an industry the first principles of which were just beginning to be understood seventeen years ago. The best proof of the advantage of manufacturing on a large scale is the success of the establishments so operating, such, for example, as the Westinghouse companies, the Western Electric Company and the Electric Storage Battery Company, and the benefits their work on broad lines have conferred on the science.

In another direction the industrial combinations present an important national advantage. The United States has been rather late to develop foreign markets for its manufactures. It has to contend in that quarter with countries that have occupied the field for scores of years, and that have the great advantage of low-priced labor. What the so-called trusts can accomplish in that line is shown by the ability of a large concern such as the General Electric Company to compete successfully for business in foreign countries, where, if the industry it represents were scattered among a dozen or so separate concerns, the ability to bring the American product to the front, or to sell at prices that make one competitor effective, would be materially smaller.

In the supply of public service by electrical means the advantages of no competition are even greater. From the standpoint of political economy there is no more excuse for two electric-light or street-railway corporations serving the same district than there is for two competitive water-supply systems, or sewer systems, in the same streets, or even for two competitive street systems, if such a condition could be imagined, in the same municipality. By this statement no reference is intended to the advantage which monopolistic control offers for an unjust scale of prices or to the disadvantage of cut-throat competition, but simply the comparative ease of obtaining fair profits when producing on a large scale inherent in the nature of the business. Every central-station manager realizes the increased economy he would obtain in the production and distribution of electric power could he double his load without increasing the area supplied. The operation of one company instead of two gives just this advantage. The dead wood of consolidated rival sys-

tems and the wish their managers so often express for a chance to rebuild them are evidences in this line. In the telephone field there is no case which quite equals the injustice, both to the public and the companies, of competitive operation. The service of even that most socialistic of all public services, the post office, would not be hampered so much by a division into competitive systems as is the telephone service. Not only does the operation of two or more rival telephone services in one community cost the companies more per subscriber than were they consolidated, but the subscribers are required, in order to obtain a complete service, to be connected to all of them. Unfortunately where a monopoly abuses its privileges, immediate expediency dictates a course violating the principles of political economy.

The general opinion appears to be growing that consolidation is the inevitable tendency of the management of all industry, and that public legislation against it is futile, and should be given up in favor of regulation and control, a right which the sins of early monopolies have left their successors no justification for refusal.

There is now noticeable a tendency toward the consolidation of the small central stations scattered among different country towns similar to the widespread consolidation of the gas interests of the last decade. The securities and stock of the small companies are bought up by bankers in the financial centres, and often paid for entirely by the issue of bonds of the syndicate formed. The benefit from a financial point of view of this course is best evidenced by the history of the stock of the syndicates, which at first, with practically no value, has in many cases reached, in the course of a few months or years, a market value equal to that of the bonds issued, showing a doubling of the value of the property. The reason for this is not difficult to find. The syndicate manages its property on a broader policy, has a better credit, can obtain a lower rate of interest on its securities, make better terms for apparatus and supplies, and is able to cut down operating expenses by increased investment. The change is thus, as a rule, a beneficial one, although, like many other contemporaneous industrial changes, it takes the control out of the hands of local owners into the hands of a few bankers in the large cities.

The more recent consolidations are noticeably less intended for stock speculative purposes, less accompanied by capital inflation, and tend more to the advantage of the stockholders rather than that of the promoter than did those of several years ago. The new capitalization is likely to be heavy, owing to the great returns expected by the promoters and the natural inclination of the companies consolidated to rate their property at as high a value as possible, regardless often of its productive value to the consolidated interests. In spite of this it is astonishing how the valuation of the consolidated properties, as shown by the market value of the stock outstanding, added to the bonded indebtedness, runs far above even this inflated plant account of all its tangible property, the difference being the value of franchises, rights, good will and the other intangible assets which enable corporations to pay good dividends on a capitalization much greater than that actually invested in their work.

The trust, as such, has, of course, been abolished by anti-trust legislation, but its purpose has been even better carried out by actual consolidations or by what is coming now to be called the merger company. The number of these which have been incorporated of late, and the breadth of their intended operations, are quite astounding. Some of the larger and their authorized capitalizations are given in the accompanying table. The magnitude of the investment in other single corporations which have gradually grown by the absorption and consolidation of rival interests is also little appreciated by those not in touch with the financial side of the industry. The same table gives a few figures showing this, the figures being approximate, in some cases estimated from the authorized or outstanding capital of the united companies:

	Capitalization.	Bonded Indebtedness.
MANUFACTURING COMPANIES.		
General Electric Company	$20,800,000	$6,000,000
Westinghouse Electric & Manufacturing Company, including the Walker Company	15,500,000	4,400,000
Electric Storage Battery Company	13,500,000	450,000
STREET RAILWAY COMPANIES.		
Union Traction Company, Philadelphia.	62,600,000	41,400,000
Metropolitan Street Railway Company	45,000,000	45,500,000
Third Avenue Railroad Company, including Dry Dock and Union Lines	17,700,000	10,400,000
Brooklyn Rapid Transit Company, including Nassau Electric Railroad	45,000,000	26,000,000
Boston Elevated Railroad Company, including West End	25,000,000	10,600,000
North Jersey Street Railway Company, including Consolidated Traction of New Jersey	20,000,000	30,700,000
West Chicago Street Railway Company.	13,200,000	18,300,000
North Chicago Street Railway Company.	10,000,000	8,000,000
Chicago City Railway Company	12,000,000	4,600,000
CENTRAL STATIONS.		
New York Gas & Electric Light, Heat & Power Company, including New York Edison Company	25,000,000	32,000,000
Pennsylvania Manufacturing, Light & Power Company, Philadelphia	15,000,000	
Kings County Electric Light & Power Company, including Brooklyn Edison Company	7,500,000	11,200,000
Baltimore Electric Light Company	5,000,000	
Chicago Edison Company	5,000,000	
Commonwealth Electric Company, pools with Chicago Edison Company	3,000,000	
TELEPHONE.		
American Bell Telephone Company	25,900,000	2,000,000
Pacific States Telephone Companies	30,000,000	
American Telegraph & Telephone Company	25,000,000	
New England Telegraph & Telephone Company	10,900,000	
New York & New Jersey Telephone Company	5,000,000	
Central Union Telephone Company	6,600,000	

A FRENCH ELECTRICAL LOCOMOTIVE.

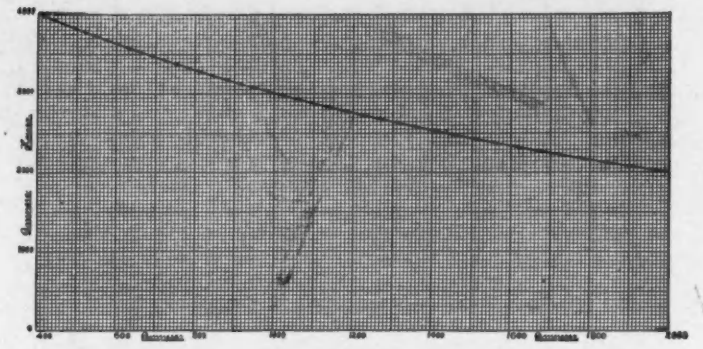
An interesting description with drawings of a heavy electrical locomotive now in experimental use on a French railway may be found on other pages of this issue. The details of this machine differ quite widely from American practice, and many of them would not be considered exactly ship-shape in this country, but the ingenuity displayed is worthy of admiration. The motors, although direct-connected, are bipolar, and rather rigidly mounted compared with American standards, although probably satisfactory on the high-class road-beds on which they are used. The greatest peculiarity of the controlling apparatus is the water rheostat and the means for adjusting it by the application of compressed air, the rheostat itself being used also as a main switch.

Latest Progress in the Application of Storage Batteries.*

BY JOSEPH APPLETON.

In dealing with this subject I shall endeavor to put before you some data and results from actual practice showing the present standing of the storage battery in connection with modern engineering practice. It has been my lot to be very closely connected with every storage battery installation of any size that is now in operation in this country, and I will describe the conditions and methods of operation of some of the most interesting of these.

The history of the storage battery in this country is curious, and probably comprises more troubles and trials than any other branch of the electrical industry. I think it will be generally acknowledged that a storage battery "per se" should be one of the most useful adjuncts in every branch of electrical engineering, but the failures



CURVE SHOWING VARIATION OF ENERGY OUTPUT WITH DISCHARGE RATE.

that were recorded in the earlier days proved that the storage battery was not then the commercial success those interested would have us believe. Until 1894 the use of storage batteries in this country proved most disastrous to all concerned. The reasons were many, but may be summed up briefly as follows:

1. The batteries were poorly designed.

2. No attention was paid to the mechanical features, the chief idea being to get the greatest capacity for the lightest weight.

3. The batteries were much over-rated, their full capacity being given as their normal working capacity.

In addition to this the storage battery business generally was in an unsatisfactory and weakly condition. Litigation was the principal cause. The fear of protracted and costly lawsuits prevented capital being invested in the business and frightened prospective users from purchasing storage batteries.

Now the conditions are very different. You are all familiar with the changes which have been made during the last five years in the commercial end of the business. All the disturbing elements have been removed, and the business has been put on a proper and substantial basis. These results are best seen from the following

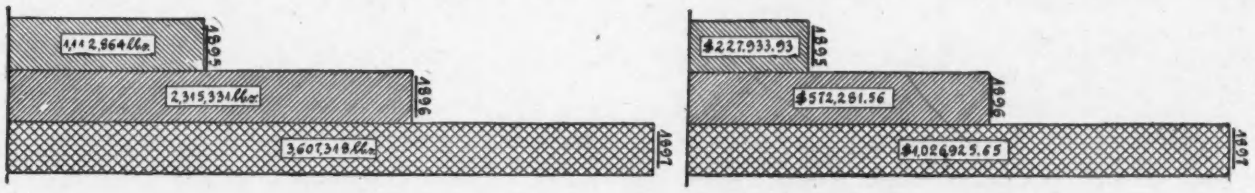


DIAGRAM SHOWING THE INCREASE IN THE USE OF STORAGE BATTERIES.

diagram. The figures for 1898 have not been tabulated, but they will show that the use of storage batteries is progressing more rapidly than ever:

1894	349,000 lbs.	Weight of Plates alone.
1895	1,112,800 "	
1896	2,315,300 "	
1897	3,607,300 "	

The storage battery is entirely different from any other piece of apparatus which is used for supplying electrical energy, being constructed and operated on the principle of chemical action instead of mechanical motion. There must, naturally, be a vast difference between these two principles.

In the mechanically operated apparatus, or generator, the output of electrical energy is the result of the conversion of the mechanical energy applied to it while in motion, and the regularity of the output is dependent on the steadiness of the mechanical energy applied and the satisfactory running of the generator and motive power. The operation is purely mechanical, and is subject to the interruptions to which all moving machinery is liable. Again, such apparatus, if overloaded to an excessive degree, will give visible signs of distress, and if the overloading is very great, or is continued, will probably give way in some mechanical feature.

In a storage battery hundreds of horse-power can be silently stored, and thousands of horse-power delivered for a short period, with no apparent action or change in the battery. The action is purely chemical, and as long as the respective elements are there to be acted upon it will surely continue. It is this fact that makes the storage battery so reliable. Such a thing as instantaneous failure or interruption of the delivery of energy is impossible, except, of course, in the case of mechanical injury to the battery from an external cause. Any mechanically operated apparatus is liable to interruption through breakage or injury to one of its parts but in a storage battery the chemical action will continue, and consequently the output of energy, until all the material on the plates has been converted.

An overload has not the same effect on a storage battery as on a mechanically operated generator. For a short period an overload, even of great extent, does not injure a storage battery. It causes the chemical action to take place more rapidly, or, to be more exact, causes more material to be subjected to the chemical action, and this, if not continued too long, or repeated too often, does not affect a good storage battery. Moreover, if the overload is continued too long, it does not mean the sudden failure and collapse of the battery and complete interruption of the output, but is shown by the premature depreciation of the plates in the battery. It may not be noticed for months, or even years. One of the most valuable features of a storage battery is that it will safely take care of any sudden and momentary overload in the system, such as grounds or short circuits, and if operating in parallel with generators or rotary converters, will relieve them of such overloads and consequent strain. I have frequently seen batteries burn out grounds on an underground system, discharging for a short time at an enormous rate. And in case of batteries operating on railway loads it is a common thing to see an occasional momentary discharge at a rate equal to twice the one-hour rate of the battery. The modern storage battery is designed to stand such occasional extreme discharges and do so without injury.

It may be well to consider before going further into our subject the question of the rates of charge and discharge of storage batteries and their capacity at different rates. Of course, this will vary somewhat with different types of battery, but not to a great extent. The more rapidly you discharge a battery, the smaller is its available capacity. For example, the curve shown above illustrates the available capacity of a storage battery when discharging at any rate between the ten-hour and one-hour rate, that is to say, when the battery is completely discharged in ten hours and in one hour. It is only within the last few years that a one-hour discharge rate has been possible with a storage battery, and it is very largely due to the fact that storage batteries can be discharged at such rapid rates that their use has been growing so rapidly.

In large engineering problems the storage battery is used chiefly to supply large amounts of electrical energy for short periods, and by increasing the allowable rate of discharge the size of the battery required is proportionally reduced. In connection with this question of the reduced capacity of storage batteries at rapid rates of discharge there is frequently a mistaken idea that if the capacity of a battery is thus reduced the efficiency is correspondingly impaired. This is not so at all. It is only the available capacity of the battery which is reduced by polarization, or, in other words, the chemical action when taking place at such rapid rates can only reach the

*Abstract of paper read before the New York Electrical Society, January 12, 1899.

active material which is on the surface of the plates and immediately exposed to the electrolyte. Hence, in reality, the actual capacity of the battery is not reduced, only the available capacity, and when the battery is recharged only the active material that is acted upon has to be converted, and not the entire amount of active material. There is a slightly greater loss in efficiency when discharging at a rapid rate due to the internal resistance of the battery, this being the C^2R loss.

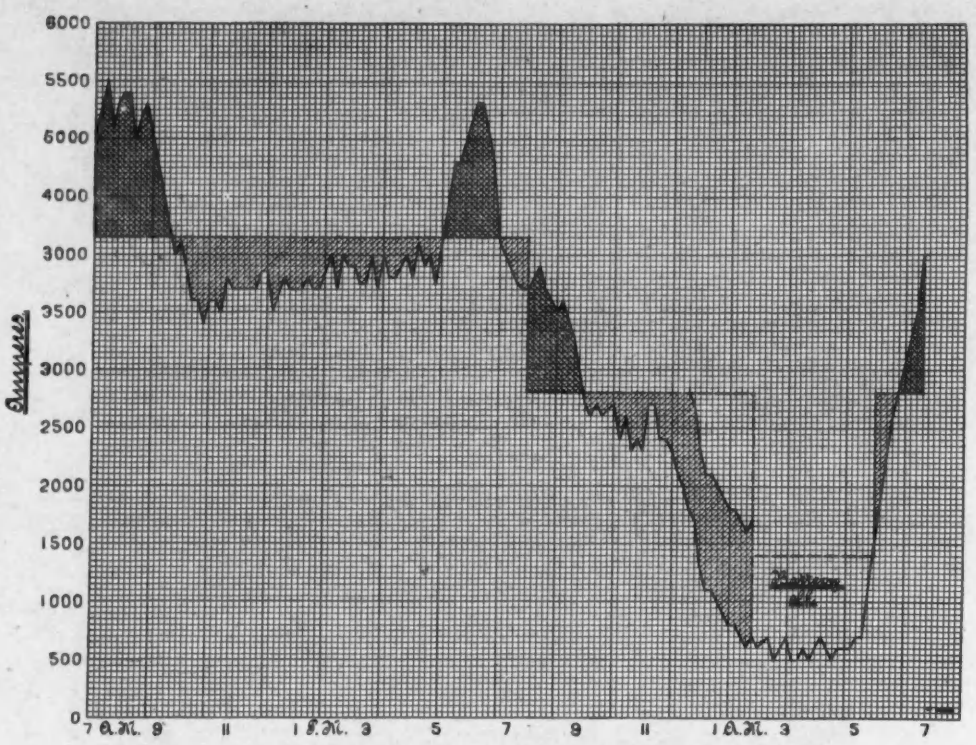
Storage batteries are not free from trouble any more than other apparatus, but under favorable conditions the comparison is much in favor of the storage battery. No piece of apparatus yet made is perfect, and its usefulness and consequent general adoption may be said to be proportional to the predominance of its useful features to its weakness or troubles. The rapid growth in the use of the storage battery during the last few years is the best proof possible that its troubles are very small compared to its advantages.

In the early days the storage battery manufacturers, in order to maintain a bare existence, had to jump at every opening for the use of a storage battery, whether the conditions warranted it or not, and in order to do business accepted contracts drawn entirely from the purchaser's point of view, without regard to the capability of the storage battery, and guaranteed results, which, to say the very least, were extremely difficult to realize. What the result of all this was you know very well.

Now things are entirely different. The business is on a commercial basis, and it is not a question of getting an order at any price but securing business which will prove satisfactory and permanent. Now storage-battery manufacturers will insist on proper conditions for the operation of their batteries or refuse to put them in. This is as it should be, and I think I am perfectly safe in saying that during the last four or five years there has not been a storage battery installed in this country except under conditions which justified its use (of course, some experimental applications have been made, which may or may not prove satisfactory, but this does not come under the head of the general application of the storage battery).

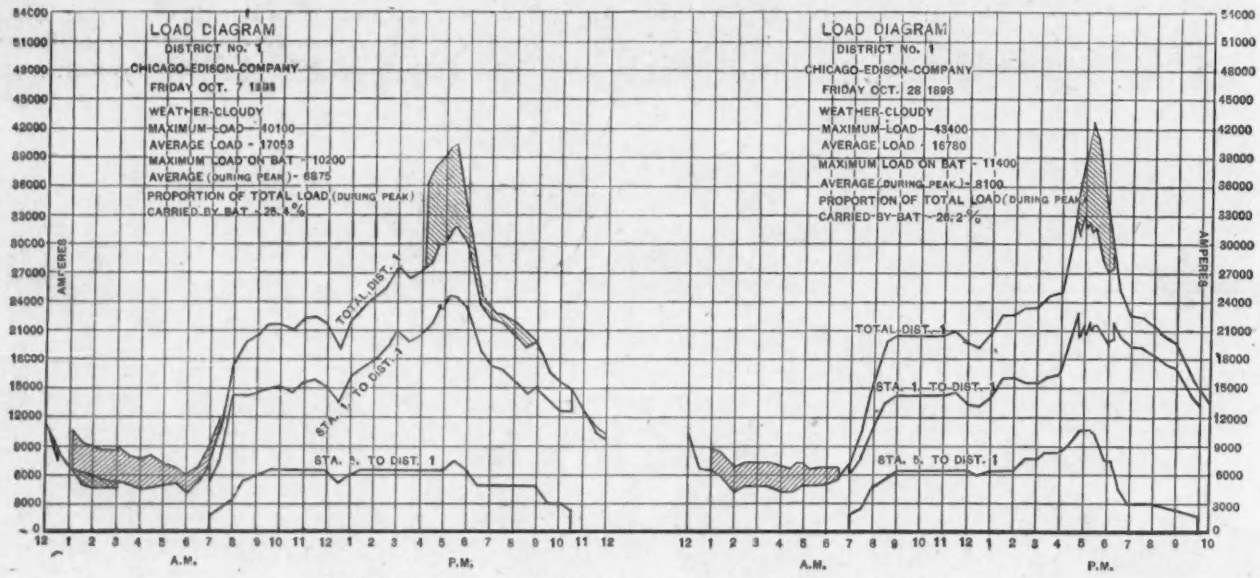
It should be distinctly understood that all conditions of electrical distribution are not suitable for the use of storage batteries, and that it is more to the interest of the manufacturer than the purchaser to confine himself only to those situations which are suitable—for every failure which is recorded is heard of one hundred times to every success.

The trend of electrical engineering to-day is toward the concentration of generating machinery, the highest possible economy in operation, and the utilization of motive power and generating machinery to the fullest extent, so that the investment may produce the greatest return. These conditions make the storage battery indispensable, for without its aid it is impossible to maintain a constant load on the power house.



Curves of Charge and Discharge, Buffalo Street Railway Plant.

Every application of electricity has its time of maximum output, or "peak," and no matter how many different applications are supplied from the same system their peaks will not fit in so as to even matters up; but, on the contrary, it is found that in many cases the peaks occur at about the same time. This is particularly noticeable with a railroad and lighting load. Again, concentration of generating machinery means a larger area for distribution, and the necessity of substations, in order to keep down the investment in conductors, and experience shows that in the majority of cases storage batteries are cheaper than the copper alone, which would otherwise be necessary, leaving out the advantages at the power house. This means that the storage battery will now play a most important part in all electrical problems, and be of sufficient importance and value to warrant the conditions being made suitable for its use, instead of, as in early days, being dumped in at any time to fill up a gap and smooth over any difficulties which cropped up.



Load Curves of the Chicago-Edison Storage Battery.

It used to be customary to refer to European practice to show

what could be done with storage batteries, and even now I believe that some people think European batteries and methods are superior to ours in this country. In connection with this idea there is one thing I particularly wish to emphasize, and that is the difference between American and European conditions. In Europe storage batteries are not subjected to the severe work they have to stand here. They are looked upon more as a reserve and are not expected to discharge at their maximum rate every day and perhaps twice on some days.

As an example of this I will tell you what one of the Tudor Company experts from Germany said when he was over here last spring. He was attending the National Electric Light Convention at Chicago, and one of the features of that convention was the large storage battery plant which the Chicago Edison Company had recently installed. During one afternoon, while the convention was being held, a very heavy thunderstorm came on, and the battery was called upon suddenly for its maximum rate of discharge, and the full rated capacity was taken out. The maximum rating of this battery was a complete discharge in one hour. Our German friend thought that was doing pretty well, but when we told him that this storage battery was installed under contract which allowed the battery to be discharged at this rate every day during the winter, he was horrified, and said, "You must not let them work the battery in that way; tell them they must hold it as a reserve." We told him that if we did that we should not be able to do any business, and that we simply had to meet these conditions, and could do so without any difficulty. This instance will show why batteries are maintained at a lower figure in Europe than here and why it has been customary to refer to the behavior of the battery in Europe.

It is a fact that we have now in this country many storage battery installations which surpass anything in Europe both in size and method of operation.

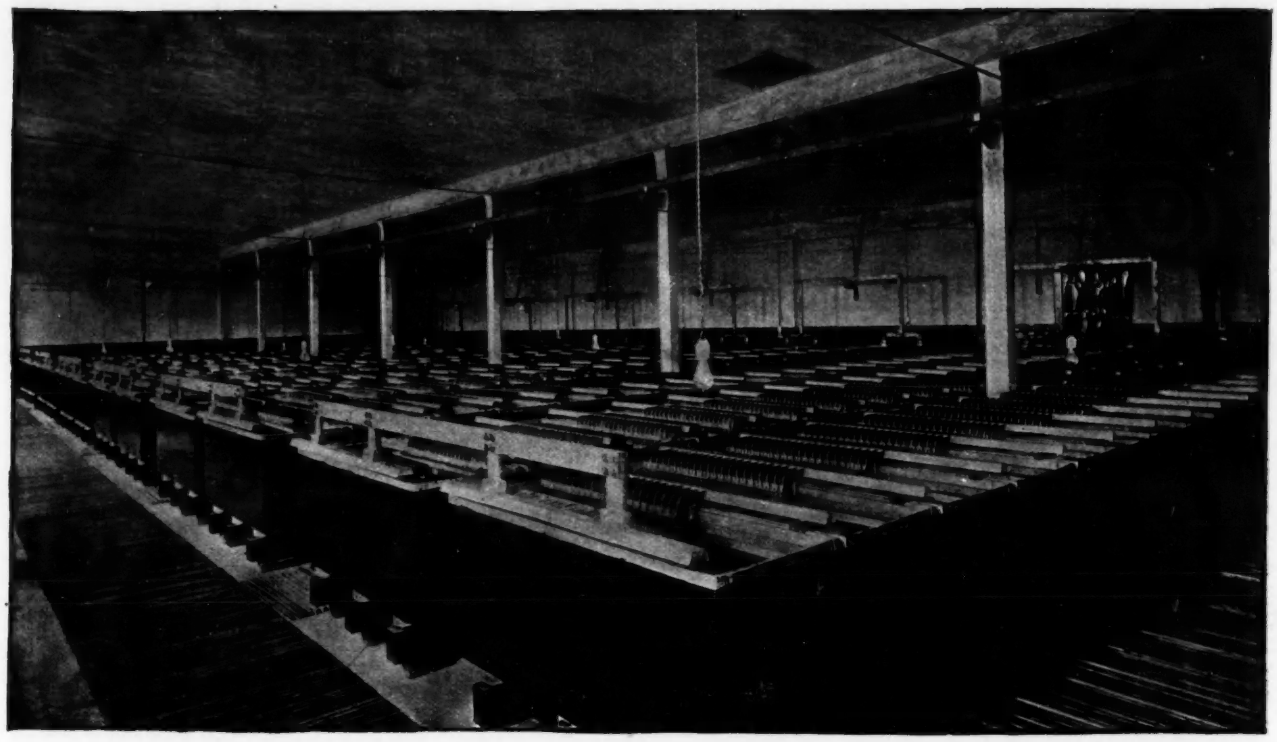
The methods of applying storage batteries in connection with electrical engineering work are so numerous that it would be impossible to deal with them all this evening, so I have selected a few for consideration as showing clearly the great flexibility of the storage battery as an adjunct to any scheme contemplating the generation and transmission of electrical energy. We will first consider the storage battery installation of the Chicago Edison Company.*

The diagram on opposite page shows the load curve for two days in the winter, and it will be seen that the battery carries about 11,000 amperes during the peak of the load, or about 26 per cent. of the total load. The advantages of batteries under these conditions will be readily seen, as they will take care of the maximum load during the short time it occurs, and will increase the load on the generators during the remainder of the time when they have to be charged.

This battery is used in addition to carrying the peak of the load for maintaining a constant pressure on the system, and relieves the switchboard attendants at the generating station from constantly watching and regulating the pressure, the battery taking care of any fluctuations automatically.

In a lighting and power station such as this the maximum load occurs for only a very short period during the year. In one station I know of 50 per cent. of the investment in generating plant and underground conductors is used only for 154 hours during the year. This statement may seem astonishing, but will be found to apply to many such stations. Where these conditions exist it will readily be seen how great are the advantages of storage batteries as auxiliaries. Their cost per kilowatt of output for short periods such as these peaks is less than the generating machinery which would have to be provided if they were not used, in addition to which there are other ways in which they prove advantageous in the operation of the plant.

The application of storage batteries to stations such as this can be made in two ways, viz., at the main power house or in substations. When batteries are placed in substations they will relieve the generating plants of the maximum load as just described, and also effect a large saving in the underground system of conductors, as at the time of maximum load the conductors between the main generating station and the substations are relieved of that portion of the load which is carried by the batteries and distributed from the substations.



THE STORAGE BATTERY ROOM OF THE BUFFALO RAILWAY COMPANY.

The use of large water powers as motive power for generating stations from which electrical energy is transmitted and distributed over extended areas is growing. Take, for example, the Niagara and other plants. In connection with such installations storage batteries play a very important part.

The power from such a plant is largely sold for manufacturing purposes, and is charged for at so much per horse-power per annum, the power being available twenty-four hours per day. The mills and factories using this power do not usually run for more than ten hours per day; therefore a man who requires a maximum of 100 horse-power for ten hours a day, or 1000-hp hours, really has to pay for 2400-hp hours, while he uses only 1000, and probably less, for the average rarely, if ever, exceeds 70 per cent. of the maximum.

With a storage battery capable of supplying 50 horse-power for ten hours, or 500-hp hours, he need only pay for one-half the amount, or 50 horse-power for twenty-four hours, as the battery

*This battery was fully described and illustrated in THE ELECTRICAL WORLD of June 11, 1898, so that its description has been omitted here.

will furnish the remainder, and can be charged during the fourteen hours he is not using the power. In addition to this the battery will take care of any fluctuation above the average, and enable the man to buy the average amount of power he requires instead of the maximum.

Such an installation has been made by the Buffalo Street Railway Company. Before describing this installation I would like to mention the different methods of installing storage batteries in connection with railway plants. These may be divided into two classes:

First—Where the battery is installed at the power house to take care of the peak of the load and the fluctuation of the generators.

Second—Where the battery is installed at the end of a long feeder to keep up the pressure at that point, and to obviate the necessity of sending the maximum amount of current over the long feeders from the power house.

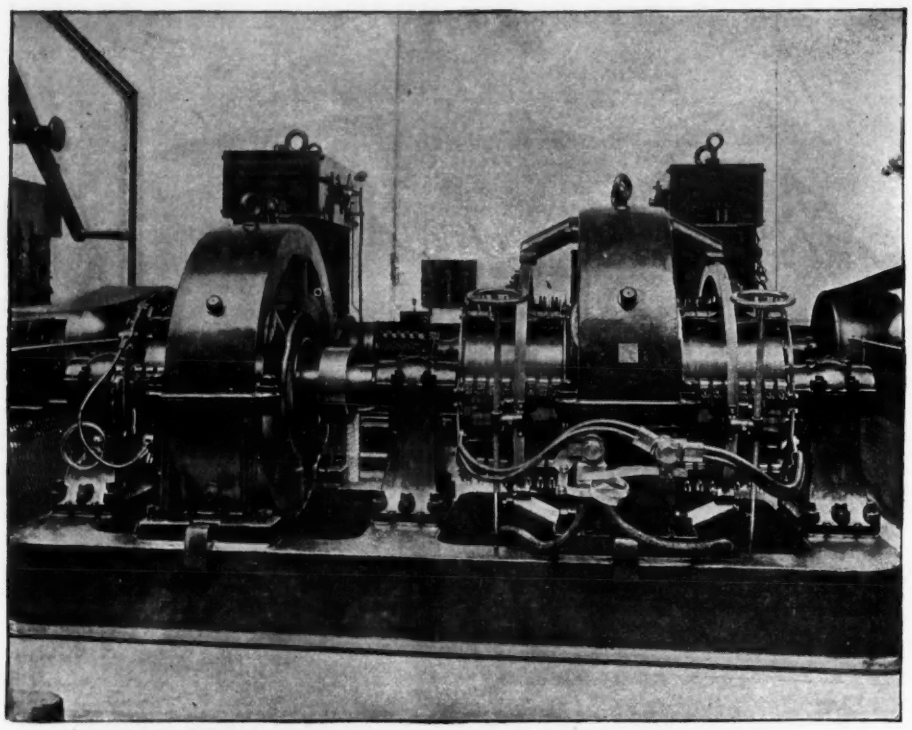
When a storage battery is installed at the power house, and is connected directly in parallel with the generators on the bus bars, some means have to be provided for regulating the voltage of the battery to suit the generators. As you know, railroad generators are overcompounded, the voltage rising as the load increases, while with the storage battery the reverse is the case, the voltage decreasing as the discharge increases. In order to make the battery work properly in parallel with generators of this type and take the fluctuations of the load, keeping the generators constantly loaded, some means of compounding the battery has to be adopted. This is done by using a compound-wound booster in series with the battery, which is so designed as to increase its voltage in proportion to the increase of load, thereby enabling it to take its proper share and keep the load on the generators constant.

The Buffalo Street Railway Company's plant is of the first class, and is especially interesting, inasmuch as it is operated in connection with the Niagara Falls power. They operate practically all the cars within the city limits, and have a steam plant capable of delivering 7000 electrical horse-power, in addition to which they take 2000 horse-power from the Niagara Falls power, this current being transmitted in the form of high-tension, alternating-current from the Niagara Falls to the power house, and being then transformed by rotary converters to the ordinary 550-volt direct current.

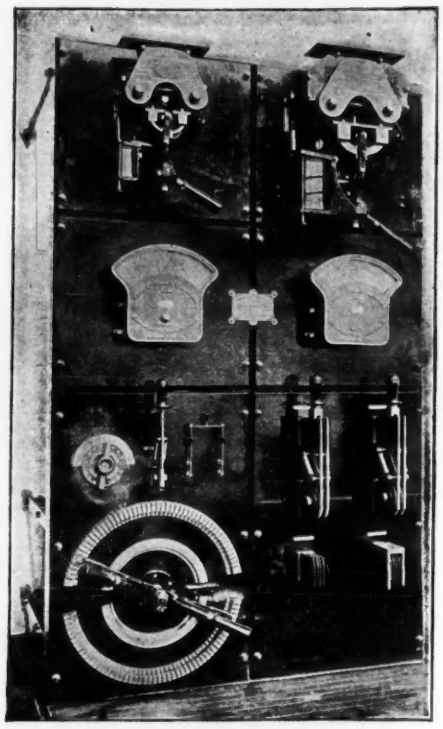
The storage battery is installed at the main power house, and is connected directly in parallel with the steam plant and rotary converters.

By the aid of the battery they are enabled to make very much more use of the Niagara Falls power. Before they installed the battery they were only able to shut down their steam plant from 11:30 P. M. until 5 A. M., during which time the rotary converters carried the entire load, which averaged about 600 horse-power, while they were paying for 2000 horse-power. With the aid of the battery they are enabled to shut down their steam plant from 7 P. M. to 7 A. M., and about eighteen hours on Sunday.

An illustration of the second method of using storage batteries for railroad work is seen in the case of the battery installation of the South Side Elevated Railway Company, of Chicago. This company operates an elevated railroad about 9 miles long, all its trains being equipped with the Sprague multiple-unit system; the power house is located approximately at the centre, and the two storage batteries near each end of the line, and are connected directly across the system without a booster. The charge and discharge of these batteries is controlled by the drop over the feeders from the power house to the batteries, this drop varying according to the load on the system from 10 to 30 volts. When the load on the system is light the drop in the feeders is small and there is voltage enough to charge the battery. When the load becomes heavy the drop on the feeders is increased; this consequently causes the batteries to discharge into the line. The method of operating is entirely automatic, the batteries discharging at times of heavy load and charging at times of light load, thereby keeping the load on the generating station practically constant. In each of the battery rooms there are installed 248 cells, having a capacity of 1000 horse-power when discharging at the hour rate.



Motor-driven Booster, Buffalo Railway Company's Plant.



Two Panels of Switchboard, Buffalo Railway Plant.

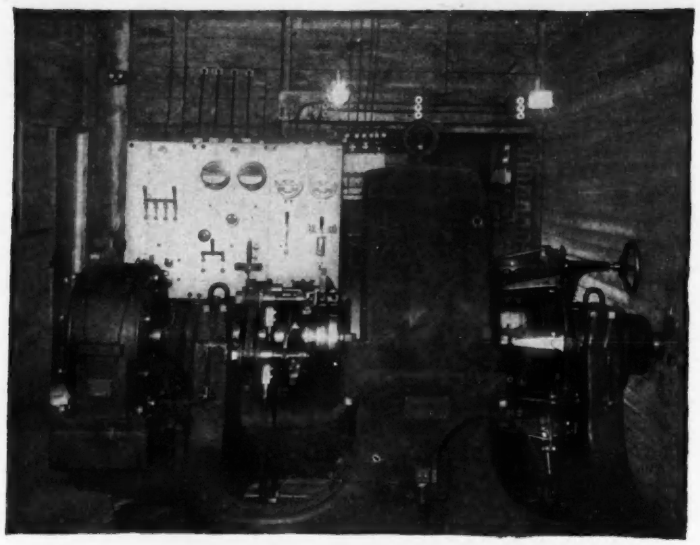
When the power house was operating without the battery during the peak of the load the maximum load was 7500 amperes, with sudden fluctuations of 5300 amperes, while with the batteries in operation the maximum load at the power house under exactly the same conditions was 5700 amperes, and the fluctuations only 2000 amperes. Thus the batteries had increased the capacity of the power house by about 2000 amperes, and steadied the load on the generators to the extent of nearly 3000 amperes. Those acquainted with the operations of railway plants will appreciate such results.

If it is found that a battery is being discharged more than it is being charged, an extra feeder is connected between it and the power house, so that it will be relieved of a portion of the load. By this means a very complete control can be maintained of the battery from the power house, and the most efficient method of operation secured.

A battery installed at the end of a line in this way increases the capacity of the power house and saves the investment in copper by making it necessary to transmit over the feeders only the average amount of currrent required, instead of the maximum,

at the same time maintaining the proper voltage at the end of the line, thereby enabling the motors to run at the point of highest efficiency. Of course the line must be long enough to justify the use of a storage battery and to supply sufficient drop in voltage over the feeders to make the battery regulate automatically as the load varies.

A variation in voltage at the end of the line, between conditions



ROTARY CONVERTER IN THE STORAGE BATTERY AUXILIARY OF THE BARRE-MONTPELIER TRACTION COMPANY'S PLANT.

of maximum load and minimum load of 10 per cent., is ample to make the battery self-regulating and take care of the fluctuating load without a booster. The following figures taken from a storage battery installation of this description, installed some two years ago, will show the advantages from a commercial point of view.

The conditions were as follows: The length of this line, at the end of which the battery was installed, was 7 miles from the main power house, running into the suburbs of a large city. The increase of traffic on this line warranted its extension 4 miles further, making a total of 11 miles from the power house. When the extension was made it was found that the feeders were quite inadequate to carry the increase of load, and it was necessary to provide additional power at the end of the line, either by laying extra feeders, installing a small power house at that point, or putting in a storage battery substation. Each method was carefully considered, and the following figures show the result: If additional feeders were laid of sufficient sectional area to provide the proper working voltage at the end of the line the cost would have been $273,000, figuring on the basis of $1 per foot laid for 1,000,000 cm. feeders. This was, of course, prohibitive. The cost of a small power house of sufficient capacity to take care of the load in that section of 750 kilowatts would have been $85,000. The cost of a battery substation complete, including real estate, was $33,000, or a saving of $52,000 over that of the power plant.

The cost of operation has proved exceedingly satisfactory, showing a saving of some $1350 per month, or $16,000 per annum, over the cost of operating a power house of such a size. The cost of operation includes all attendance, taxes and depreciation, and interest.

One of the most interesting and important storage battery installations recently made is that in connection with the underground trolley system of the Metropolitan Street Railway Company, of this city.*

We will now consider the use of storage batteries in connection with isolated plants in large office buildings and stores using electric elevators.

The modern office building, with its fifteen or twenty stories, together with the demand for quick elevator service, has greatly increased the use of high-speed electric elevators. The nature of the work the elevator has to perform, and the fact that the power required to start it is from two to three times the hoisting power, cause the elevator load to be an extremely fluctuating one, no matter how carefully the operation is watched.

The Commercial Cable Building, in this city, is an excellent example of what can be done with the operation of an electric plant of this description.*

The centralization of generating plants, and their location in districts where the facilities for obtaining coal and water are good, has developed the system of high-tension alternating transmission and the distribution of direct current through rotary converters. This seems to be the one which will be employed in most of the large engineering undertakings to be solved during the next few years. The advantages of direct current for distribution over the alternating are so marked that at least until further improvements are made in alternating-current distribution the direct current will undoubtedly be the most generally used. With this system of large central power house and substations for distribution through rotary converters storage batteries are almost essential. They reduce the size of the generating plant in the first case, and also the size of the rotary converters, and enable them both to be operated with a much greater load factor than would be possible without.

The installation of the Hartford Electric Light Company, with which you are probably familiar, was the first of this description in this country, and has proved the many advantages which were claimed for such a system.

An interesting application of this sort has recently been made on a small railroad plant in Montpelier, Vt. This plant was, I believe, the first railway plant in this country operated exclusively from rotary converters with a storage battery auxiliary. The line operated is about 9 miles long, and the substation is located about three miles from one end. The power is furnished from a power house on the Winooski River, the current being generated by 3-phase alternators at 2200 volts. This current is carried to step-up transformers, and is raised to 6300 volts. At this pressure it is carried to the substation, a distance of 8 miles. In the substation step-down transformers reduce this to 480 volts, at which pressure it is fed into the rotary converter. The capacity of this converter is 160 kilowatts, and it is especially wound for running directly in parallel with a storage battery, its characteristic curve being similar to that of a shunt-wound generator. That is to say, as the load increases, its voltage falls. By this means the battery will take care of all the fluctuations, maintaining a fairly constant load on the rotary. The battery consists of 248 cells, each containing eleven plates 10 inches square. The one-hour rate of this battery is 200 amperes.

Most of the plants dealt with so far have been those of a large size, supplying a large amount of energy. It must not be imagined that storage batteries are applicable only to these large stations. The results obtained from their use are just as satisfactory in the case of smaller stations, but I have referred to the larger ones as

EXTERIOR OF PRIVATE RESIDENCE LIGHTING PLANT.

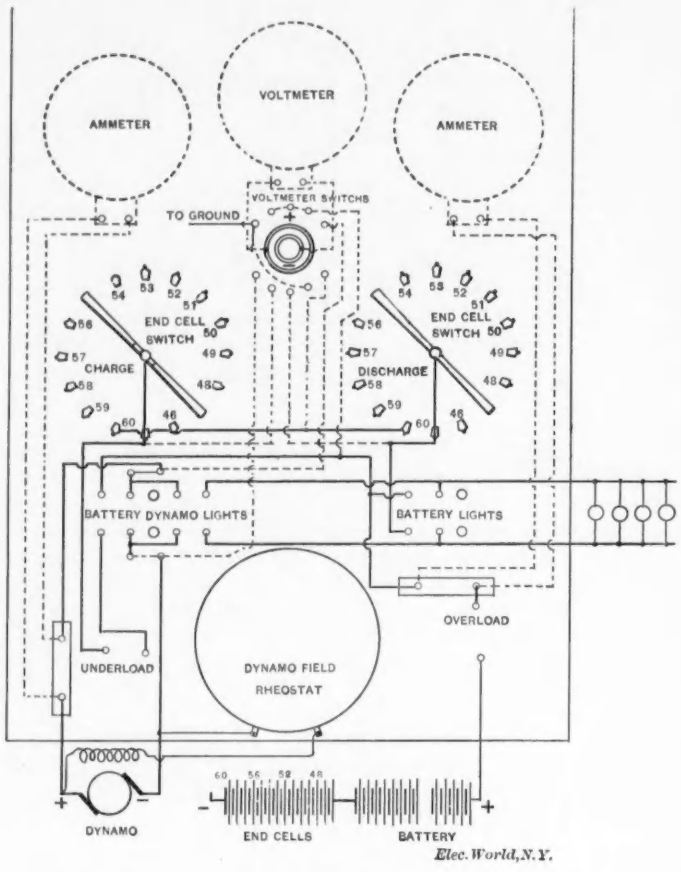
being of more interest. I will, however, give the results obtained in one of the smaller type.

The Claremont electric light plant, Claremont, N. H., is a small plant operated by both water power and steam. The plant consists of

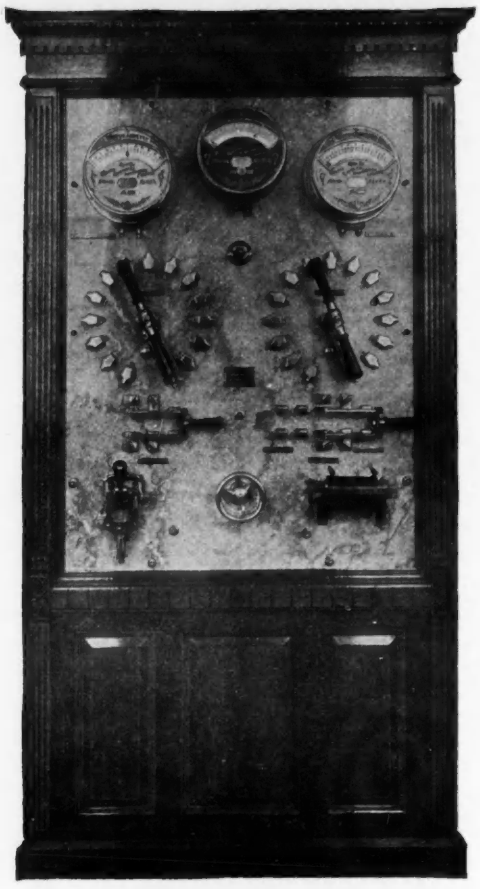
*For a description of this installation see THE ELECTRICAL WORLD, January 21, 1899.

See THE ELECTRICAL WORLD, November 6, 1897.

two Edison bipolar dynamos running on the three-wire system and an arc-light service of fifty lights supplied by a Thomson-Houston dynamo. In connection with the Edison dynamos, which are operating on the three-wire system, there is a battery plant of 134 cells, containing eleven plates in each cell 10 feet square. These batteries are operated directly in parallel with the dynamos and relieve them



Switchboard Connections, Private Residence Lighting Plant.



The Switchboard of Private Residence Lighting Plant.

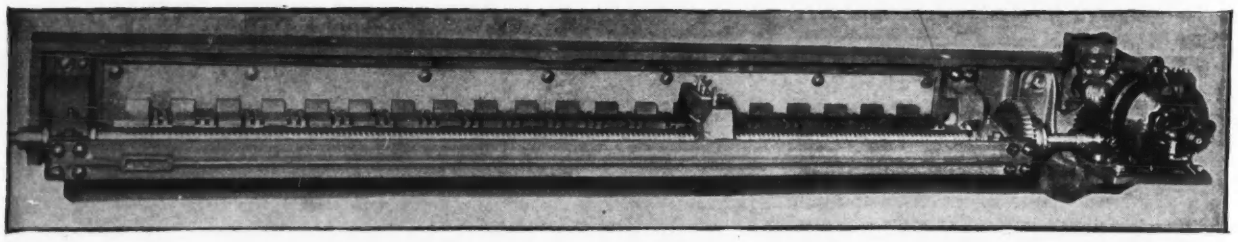
of a portion of the load during the time of heaviest amount. They also help out the steam plant, enabling the water power to be used to its fullest advantage.

Take, for example, the following figures for the month of January, 1896: Before the batteries were installed it was found necessary to run an auxiliary engine 180 hours to supplement the water-wheel. During the same month in 1898, after the battery was installed, the same conditions as regards water power prevailing, the station load was 33 per cent. heavier, and it was only necessary to run the auxiliary steam engine 133 hours during the month. In addition to this saving the service given was far superior owing to the steadier pressure which was maintained. The battery has also enabled them to reduce their staff. The entire force employed in this plant now consists of a superintendent, a dynamo attendant and a lineman; the lineman also attends to the lamp trimming. Before the battery was installed there was in addition an engineer, while the average load was considerably less than at the present time.

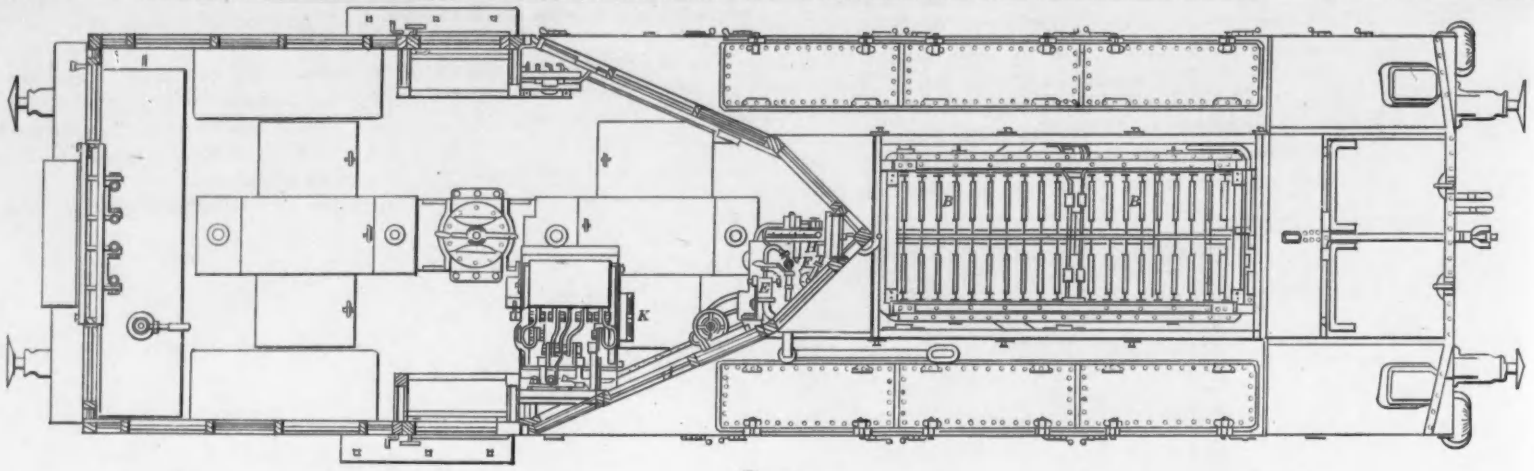
There is one application of storage batteries in connection with central stations which I believe will in time become very general, but which at the present time has only been tried in a few instances. It is the use of storage batteries in office buildings, stores, etc., in-

stead of the usual isolated plant or direct supply from the central station. The method of operation is as follows:

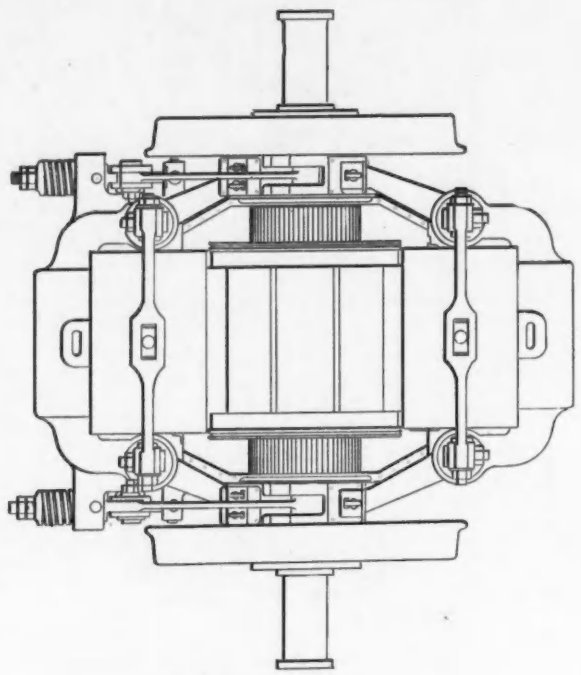
During the few hours of maximum load at the central station the storage battery supplies the entire current for the building, it being disconnected from the street mains. During the hours of light load the building is connected with the street mains and the battery charged from them. By this means the central station can take as customers these buildings, and only have them on their system during the hours of light load. This is a class of customers which is not profitable for the central station in the ordinary way, as they have a large number of lamps which are only used for a short period, and that at a time when the station has its maximum load. This means that they have to provide capacity for these lamps, and yet the plant is only needed for an hour or two a day. In one installation of this sort the electric light company claims it can charge the battery at a time when it is glad to sell current for 4½ cents a kw. hour, and it takes a load off their system at a time when current is worth 13 cents. This leaves a good margin for profit for both user and electric light company. The cost of such a battery plant is less than the isolated plant would be for the same capacity, and it occupies very much less space, which in some buildings is an important matter. By this method the central station can also take customers having a fluctuating power load without feeling its disturbing effect on the system, the battery maintaining an even pressure at all times. This is particularly advantageous when the fluctuating load is some distance from the power house and the feeders are not large.



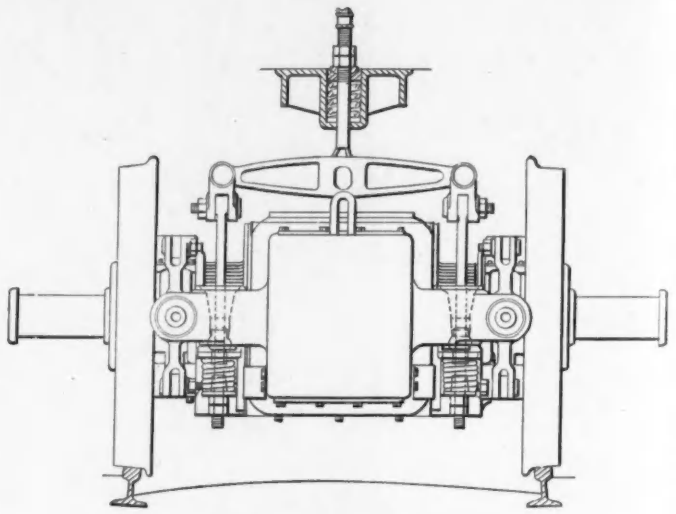
A Storage Battery End-Cell Switch.



PLAN.

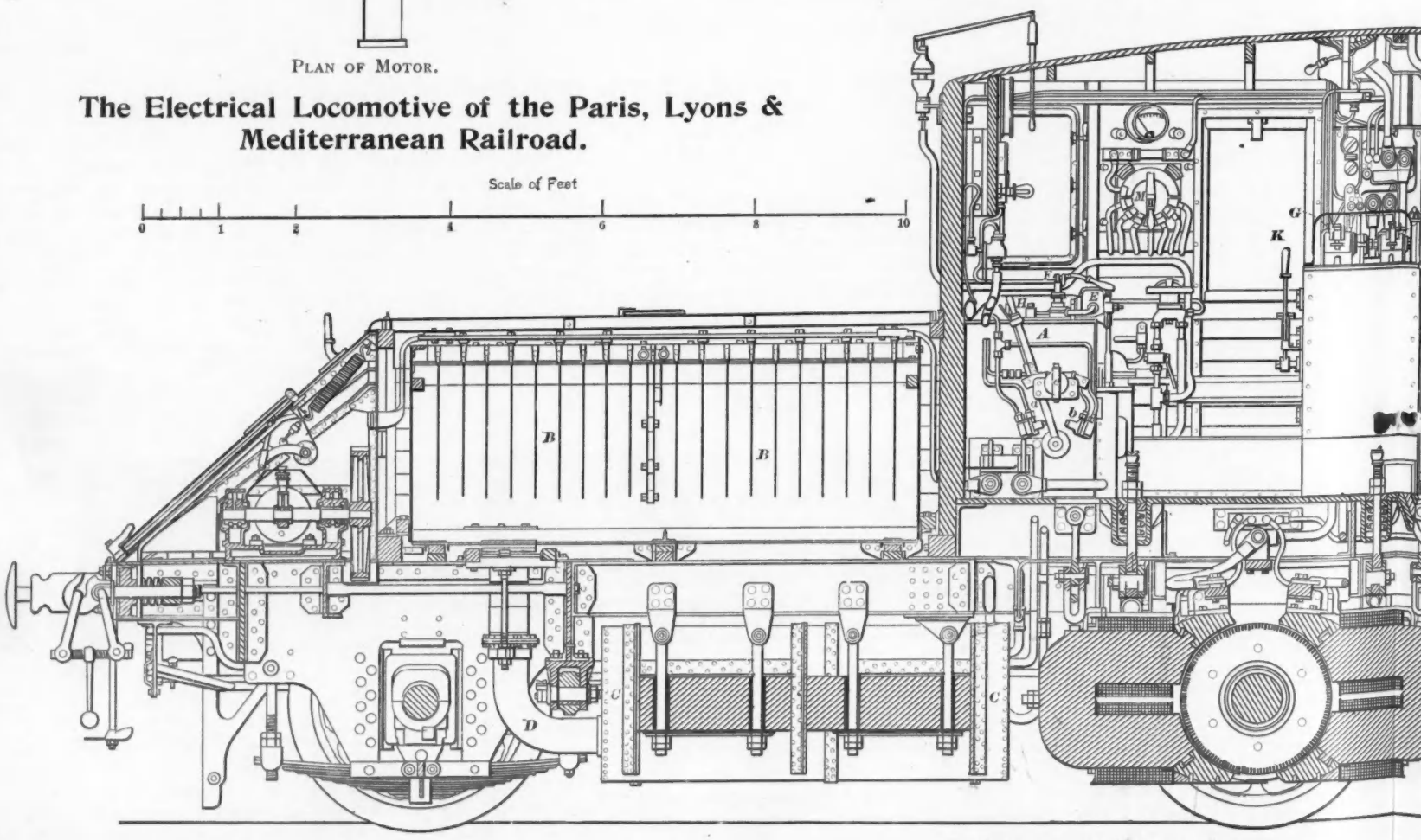


PLAN OF MOTOR.



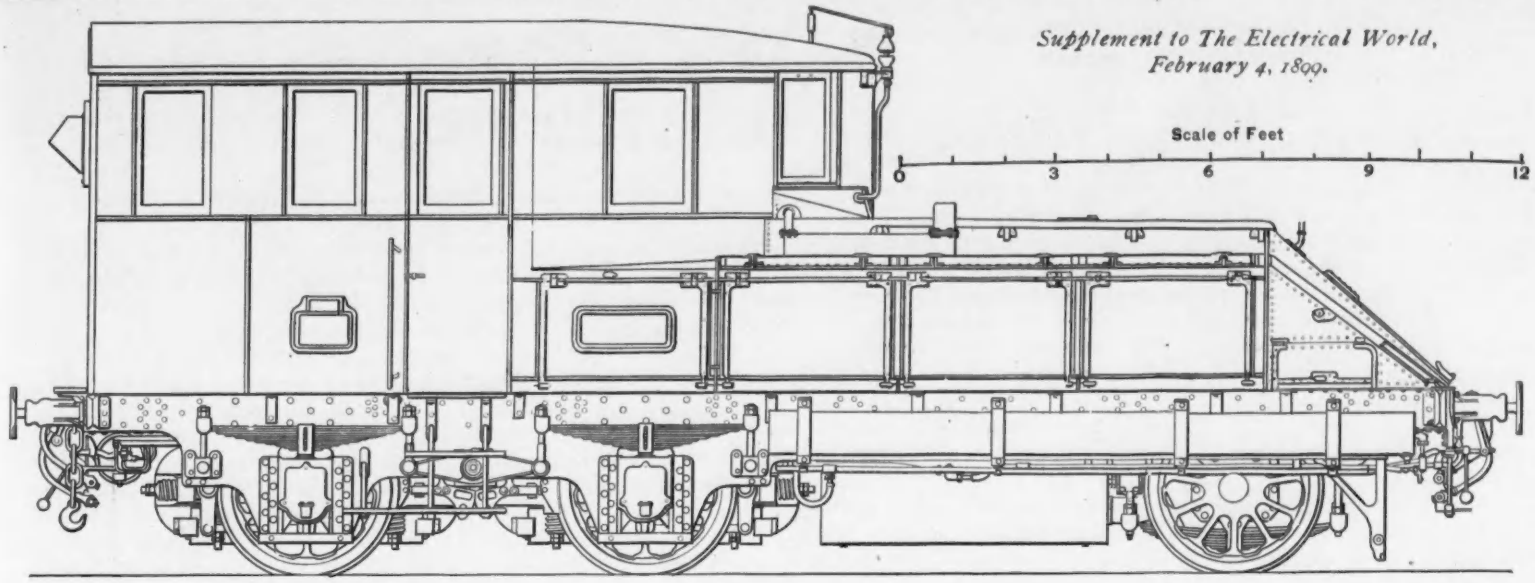
END ELEVATION OF MOTOR.

The Electrical Locomotive of the Paris, Lyons & Mediterranean Railroad.

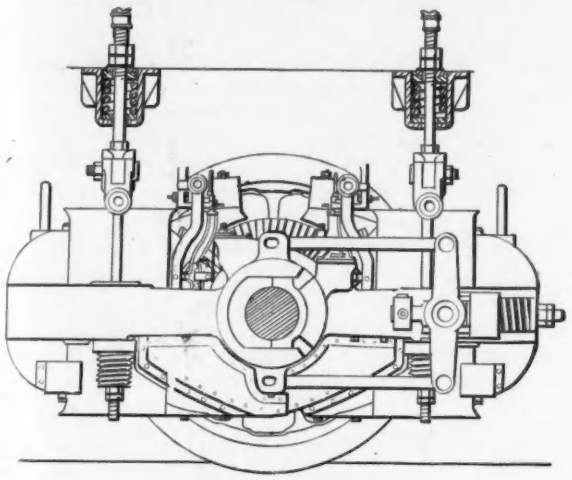


LONGITUDINAL VERTICAL SECTION.

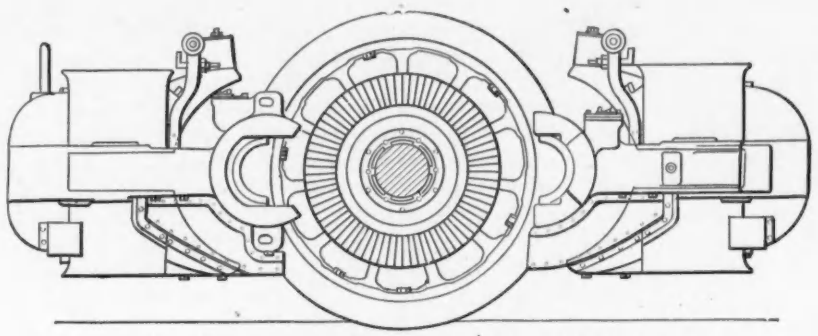
Supplement to The Electrical World, February 4, 1899.



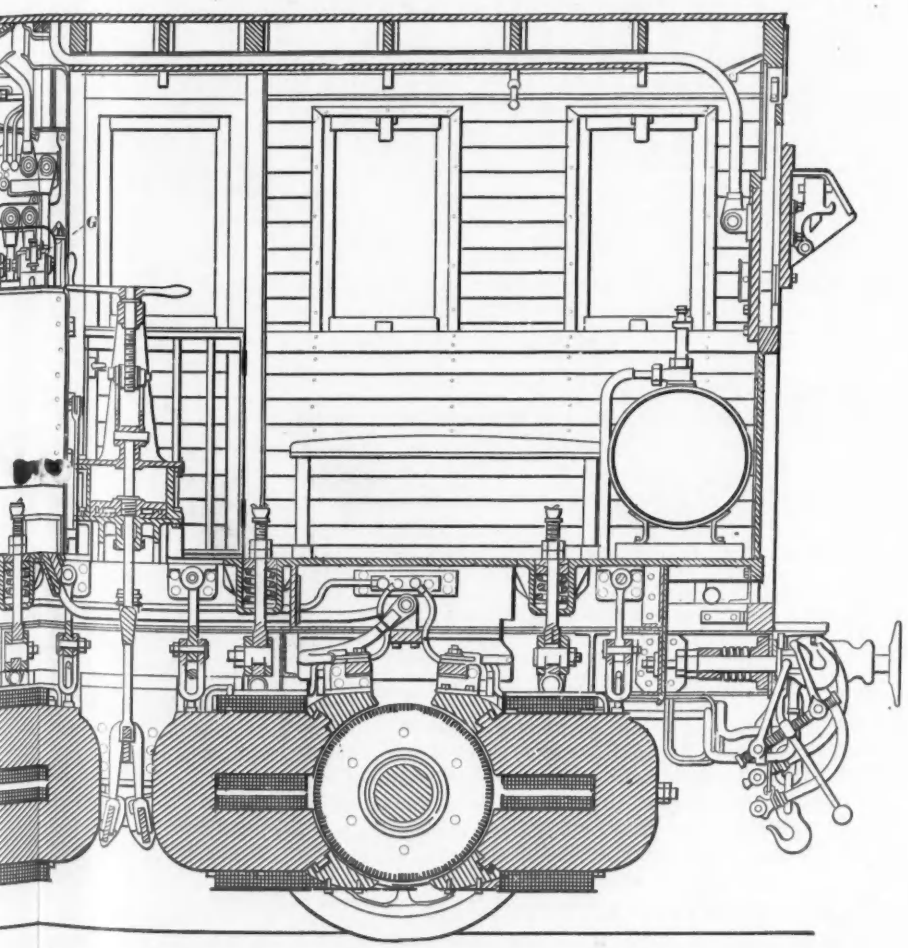
SIDE ELEVATION.

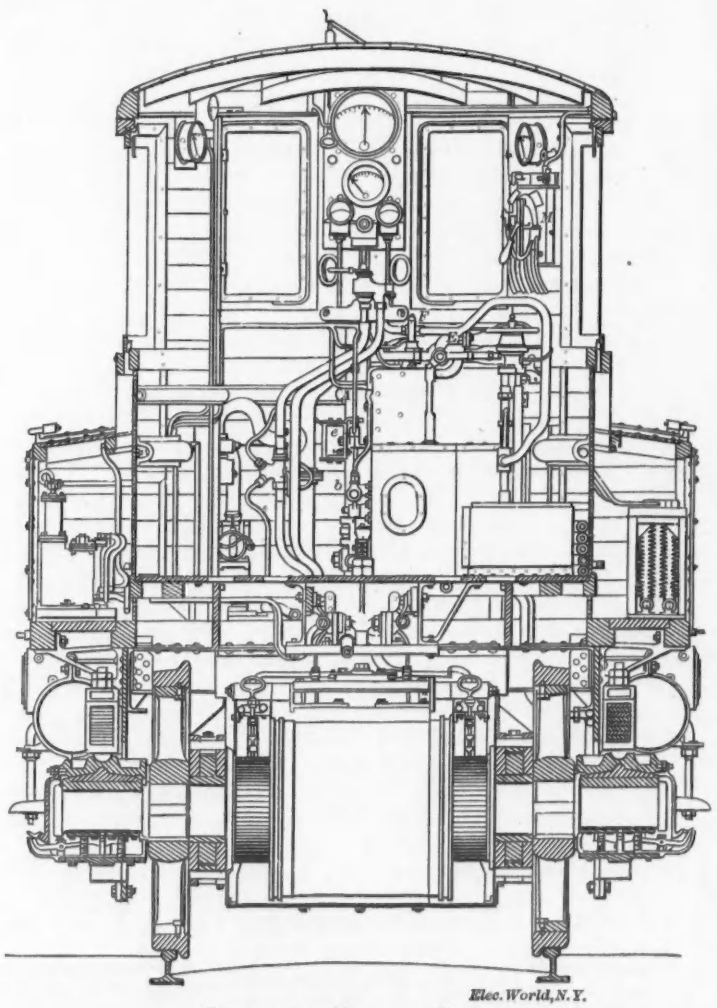


SIDE ELEVATION OF MOTOR.



SIDE ELEVATION OF MOTOR WITH FIELDS REMOVED.





Elec. World, N.Y.

TRANSVERSE VERTICAL SECTION.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN

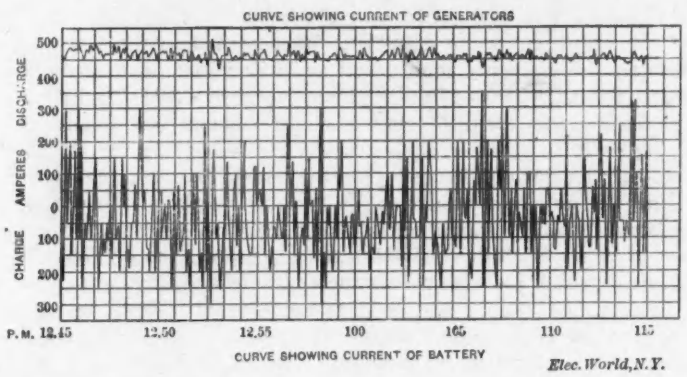
The use of storage batteries in connection with isolated plants for private houses is increasing very much. Such a generating plant without a battery requires a lot of attention, as the engine and the dynamo must, of course, be kept running all the time current is required, and, moreover, it runs under a variable and uneconomical load.

With a storage battery, however, current is available at any time, and the generating plant need only to be run to charge the battery or when an unusually large amount of current is required for special occasions. This class of work is very light on the storage battery, as usually it is only charged two or three times a week, and only discharged for a short time every day. Such a plant is illustrated in the accompanying figures.

The power house is situated about 100 yards from the residence, and is 21 feet long by 16 feet wide, divided into two rooms, one for the engine, dynamo and switchboard, and one for the storage battery. The residence is wired for 300 16-cp lamps, and the plant consists of a 19½-hp Otto gas engine, belted to a shunt-wound dynamo of 12½ kilowatts capacity, wound for a range of voltage of 110 to 150 volts.

The storage battery consists of sixty cells, each containing thirteen plates 10½ feet square. These elements are mounted in glass jars, placed in sand trays. The plates hang on the sides of the jars, small lugs being cast on them for this purpose. The capacity of the battery is 60 amperes for eight hours, 84 amperes for five hours, 120 amperes for three hours. The switchboard is built in the partition between the battery and engine room, so as to save space and to allow a free access to the back of the board. The circuits are so arranged that any combination can be effected, viz., to supply lamps while charging the battery or to charge the battery alone; to supply the lamps from either battery or dynamo direct, or with the two running in parallel.

The plants that we have considered will give some idea of the numerous methods of applying storage batteries to electrical work. There are many others which we might have touched upon, but the time is too short, as you will see. The field for the use of the storage battery is practically unlimited, and comprises every branch of electrical work, and the problems involved are some of the most interesting which electrical engineers have to consider.



CURVES SHOWING VARIATIONS IN RATE OF CHARGE AND DISCHARGE OF STORAGE BATTERY AUXILIARY IN THE PLANT OF THE COMMERCIAL CABLE BUILDING, NEW YORK.

The storage battery of to-day is a practical piece of apparatus; the days when it was considered an experiment have passed. Large sums of money are being expended in experiments to reduce the cost of manufacture and lighten the weight, and it is in these directions that the greatest improvements may be looked for.

Resting Upon Their Ores.

The London "Electrical Review," in graceful acknowledgment of American engineering successes, makes the following statement, embodying a pun, which, whether intentional or accidental, meets the sense of humor of Americans as an English pun rarely does. "American enterprise and energy are being well rewarded. America's success in relation to the world's iron and steel business seems to be as great as her electrical prosperity. Our manufacturers must not rest upon their ores because of the existence of a more pronounced friendliness for the States. . . . . ."

Inductive Loads (Arc Lamps and Motors) on Alternating Current Transformers.*

BY PROF. D. C. JACKSON.

Since my paper on the choice of transformers, read at the Chicago meeting of this association, there has been no dearth of production in the literature of the transformer; but in all that has been written there is practically no discussion of the limits of reactive transformer drop which may be permitted when incandescent lamps are to be run on the same circuit as inductive loads. The inductive loads which are common to-day are arc lamps and motors. As it is not usual to operate large motors from transformers to which incandescent lamps are connected it is not necessary to give much attention here to the motor question. I will, therefore, bring your attention particularly to the effect of arc lamps, or fan motors, when connected to transformers.

It is now well understood among central-station men that, in addition to the resistance "drop," transformers are affected by a reactive "drop," which is caused by the effect of magnetic leakage, or the so-called self-induction of the transformers; and also that inductive loads increase the defects in regulation which are exhibited by transformers on non-inductive loads. I propose to proceed at once without explanation to illustrate the magnitude of the latter effect when arc lamps, for instance, constitute the transformer loads.

Reactive drop has a geometrical direction which is at right angles to the direction of resistance drop, so that the total drop of the transformer is not made up of the arithmetical sum of the two. Indeed, in order to know the total drop or defect in regulation of any transformer, it is necessary to know the exact character of its load.

In the discussion we will assume three 5000-watt transformers for 60 frequency: the first with 3 per cent. reactive drop; the second with 5 per cent. reactive drop; the third with 7 per cent. reactive drop, and all with 2 per cent. resistance drop at full load. We will assume a constant primary pressure of 1120 volts at the transformer. With 10:1 ratio in the transformer this results in 112 volts secondary pressure for either transformer at no load.

We are now in a position to examine the effect of loading on the transformers, and will begin with the first one, which has a 3 per cent. reactive drop at full load. This is equal to 3.36 volts on the secondary side. There is also a resistance drop of 2 per cent. at full load, or 2.24 volts. With a non-inductive or incandescent lamp load, the drop is the hypothenuse of the triangle, the sides of which are the resistance and reactive drops. This becomes 2.3 volts, giving a secondary pressure of 109.7 volts.

We will now suppose this transformer to be loaded with arc lamps, each absorbing 500 watts, with 70 per cent. power factor. Seven of these lamps give an apparent load of 5000 watts, and therefore require the full current output of the 5000-watt transformer. The question now is: What will the secondary transformer pressure now be for the first transformer when the primary pressure is 1120 volts? Under the conditions which we have here, the secondary current is caused to lag behind the secondary terminal pressure by the reactance in the arc lamps. The magnitude of the lag in degrees is the angle which has 0.70 for its cosine, or 45½ degrees. The secondary pressure is now 108.0 volts. The arc-lamp load, therefore, increases the total drop to four volts.

The conditions when the second transformer is used are more serious. The reactive drop of this transformer at full load is 5 per cent., or 5.60 volts, and the resistance drop is 2.24 volts. When the full load is composed of incandescent lamps (that is, it is non-inductive) the secondary pressure is equal to 109.6 volts. When the transformer is loaded with arc lamps, as previously described. The point of the secondary pressure, which is 106.4 volts.

In the case of the third transformer, when loaded with arc lamps, the secondary pressure is only 104.8 volts.

It is now useful to inquire what effect upon the secondary pressure is produced by changing the power factor of the arc lamps. With a power factor of 50 per cent. only five 500-watt lamps are carried by the 5000-watt transformer at full load, and the secondary pressure is 104.1 volts with the five lamps connected.

The facts deduced in the preceding paragraphs show clearly that it is necessary to use transformers with little reactive drop in case inductive loads are operated from the same transformers as incandescent lamps. In these days of improved distribution with secondary mains covering considerable districts it becomes most natural to

*Abstract of paper read before the Northwestern Electrical Association, Milwaukee, January, 1899.

connect fan motors and enclosed arc lamps to the regular distribution circuits, and indeed this is the proper arrangement. On the other hand, if the addition of an arc lamp to a circuit causes an added drop of a full volt, the cost in regulation is too great for the arc lamp to pay. The query arises, how can the difficulty be avoided? The answer to this query is simple. Purchase transformers with a guaranteed reactive drop, with 60 frequency, not exceeding 5 per cent. at full load in any size, and not exceeding 3 per cent. at full load in the larger sizes. Many of the older transformers show a reactive drop with 60 frequency which exceeds 10 per cent. at full load, and some even approach 20 per cent. It may be of interest to see what the effect of an inductive load is in the latter case.

A reactive drop of 20 per cent. equals 22.4 volts upon the basis of the primary pressure used above. We will assume, as before, that the resistance drop at full load is 2 per cent., or 2.24 volts. With a primary pressure of 1120 volts and a full load of incandescent lamps, the secondary pressure is 105.5 volts, and the total drop is 4.5 per cent. When the load is made up of our seven arc lamps of 70 per cent. power factor, the secondary pressure falls to 93.5 volts, and the total drop is 18.5 volts, or 16½ per cent. This is over 2½ volts per arc lamp, and is too great a drop even for the arc lamps to work satisfactorily. It should be borne in mind that the figures which I give are based on a current frequency of sixty periods per second. Higher frequencies cause the reactive drop to be greater.

A determination of the reactive drop in a transformer is readily made as follows: Short circuit the secondary coil through an amperemeter and connect the primary coil to a lighting circuit through a variable resistance. Adjust the resistance until a normal full-load current is indicated by the amperemeter. Then the reading of a voltmeter across the terminals of the primary coil gives the total drop of pressure. The reactive drop may be deduced by taking the square root of the difference between the voltmeter reading and resistance drop. The resistance drop is found directly from the copper loss by dividing it by the amperemeter reading. The copper loss and reactive drop may be determined by a single set of readings, when testing a transformer, by adding a voltmeter across the primary terminals of the transformer represented in Fig. 2 of my paper on "Choice of Transformers," read before the Chicago meeting of this association in 1895.

We now reach the question of the power factor of alternating-current arc lamps. In some of the various lamps which I have tested the power factor has been as low as 50 per cent., and in others it has been greater than 70 per cent. It is very desirable that the power factor of a lamp shall be high in order that the current required to operate it at a fixed wattage shall not demand too much transformer capacity. If the power factor of the arc lamp is 50 per cent., the transformer capacity required for its operation is just twice as great as that required to furnish an equal wattage to incandescent lamps in which the power factor is 100 per cent.

It is entirely possible to get a high power factor in a lamp by the substitution of a wasteful resistance for the usual reactance coil, but this introduces a positive waste of energy which is most undesirable. The lamp which is to be desired is that which (all other things being equal) centres the required power (say, for instance, 400 watts) in the arc accompanied by the least total absorption of power in the lamp, as shown by wattmeter readings, and by the highest power factor. Lamps that are purchased should be tested by the central-station men for

1. Watts absorbed in the arc;
2. Watts absorbed by the lamp, as a whole;
3. Voltamperes absorbed by the lamp.

This is a matter of but a few minutes' work, provided the necessary instruments are available.

Good, enclosed arc lamps, connected to the ordinary constant-pressure circuits, fed from good transformers, are satisfactory and profitable devices. But, in making a test of this proposition, if you admit either poor lamps or poor transformers to the combinations, you will plunge yourself into disappointment and possible loss.

An Electric Railway for Breslau.

United States Consul Erdman, at Breslau, Germany, informs the State Department at Washington that the street car company of that city, which is now using horse power, has been granted the privilege to employ electric power at the expiration of its present charter, which will be in 1902. The consul desires to bring this fact to the attention of American manufacturers of and dealers in street car rails, motors, and supplies in general.

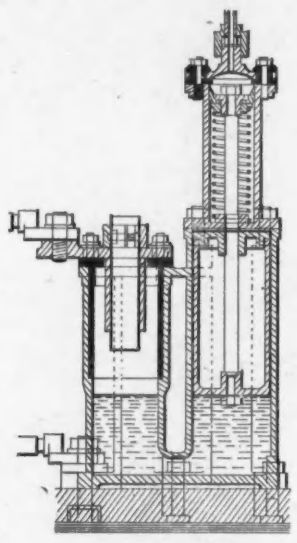
The Electrical Locomotive of the Paris, Lyons & Mediterranean Railroad.

One of the leading railway corporations of France, known as La Compagnie Paris-Lyon-Mediterranée, has for several years seriously considered the extensive application of electric traction. Some of its suburban branches and lines through tunnels, difficult of ventilation, as well as some sections on the Swiss frontier, with very high grades and abundant water power, appear to offer the most advantageous conditions for electrical work, and for this reason the company has been experimenting in two different ways in the study of electric traction, one of these the general arrangement of the motors and the other the system of conductors. The company decided in 1893 to build a high-speed electric locomotive, of small power, to be sure, compared with standard steam locomotives, but with a small number of propelling units, so that by their duplication normal powers can be obtained. This locomotive was finished in September, 1897, and during the next year fitted with a powerful storage battery in a special tender with which it has now been in experimental service some eight months. The storage battery is, of course, not intended as a permanent feature of such working, but the results obtained with it will give accurate data as to the performance of a locomotive with any other equally reliable source of current. It is the intention of the officers of the company to utilize the data so obtained in the design of a complete electrical system for the operation of the main line from Paris to Melun, with branches aggregating about 65 miles in length, supplied from several power houses. The general design of the locomotive is clearly shown in the drawings of the accompanying supplemental sheet, which were reproduced from an able article on the subject in "La Revue Générale des Chemins de Fer," by M. Auvert, the engineer who has had particular charge of the work.

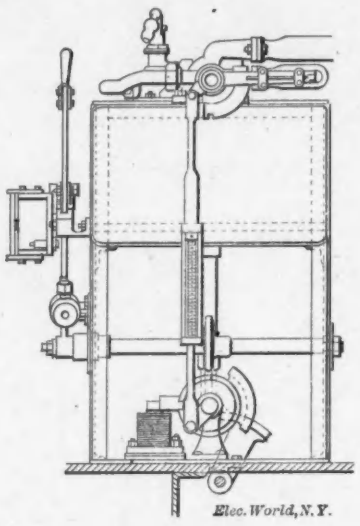
The body of the vehicle is very oddly shaped, consisting of a low foreward chamber and a cab with a V-shaped front, evidently intended to minimize wind resistance. The running gear is laid out very much on standard French lines, there being three axles, the leading one being idle and the other two driving. All six wheels are of the same diameter, about 44 inches, the wheel base between drivers being about 7 feet and wheel base over all about 20 feet. The axle boxes of the leading wheels are inside, and support the load upon them through inclined planes, the arrangement being such that the wheels on curves can move laterally for about one-half an inch either side of the mean positon, the inclined planes tending to centre them. The total weight of the vehicle is 97,000 pounds, of which considerably over two-thirds is borne by the drivers. Each driving axle carries a bipolar motor, four detail views of which are shown near the centre of and across the accompanying supplement. The field of each motor is made up of two soft-steel horse shoes, with polar extensions tongued and grooved, so that the windings may be removed. The four field coils are so connected that the four poles presented to the surface of the armature are not alternately positive and negative, but both poles above a horizontal plane passing through the shaft are of one polarity and both poles below the other. The armatures are mounted directly upon the wheel axles, which are fitted with journals inside the wheels as well as outside, as the transverse sectional elevation of the vehicle clearly shows. The field magnets are attached to frames connected through cushions with the boxes of these inside journals, thus maintaining them concentric with the armatures, the weight of the field magnets being carried largely through a spring suspension from the body of the locomotive, with proper balance levers for distributing the strains, as the detail drawings show. The armature has a diameter of 27 inches and an active length of about 22 inches, the winding consisting of 150 copper bars, each with a cross section of about one-tenth of one square inch, insulated in tubes of micanite. Each armature is fitted with two commutators, one at either end, on each of which bear two sets of carbon brushess.

Of the several chambers above the floor of the vehicle the one furthest forward contains an air compressor driven by a small 4-kw motor to give the compressed air for the Westinghouse brakes, the whistle and the various controlling devices, described below. The pump motor is shunt wound, and is controlled by a hand rheostat. To the rear of this chamber are three low compartments, over which the driver may look from the cab windows. Those to either side contain eighteen storage cells, with which the loco-

motive itself is fitted, for separate field excitation, auxiliary motor work, etc., while the central chamber contains an ingenious water rheostat for controlling the main current. This rheostat consists of a rectangular iron box or tank insulated on a wood and rubber frame, having a capacity of about 60 cubic feet. Into this box hang twenty lead plates, arranged very much after the fashion of the plates of a storage battery, separated by about 4 inches, the alternate plates being connected together to give a large surface of contact. These plates are shown in the drawings at *B B*. Hanging from the floor almost immediately below this water rheostat is a large cylinder or reservoir, *C*, suspended in such a way that it is insulated from the car body. This connects with the bottom of the rheostat tank through a 6-inch pipe *D*, and is filled with water containing a solution of carbonate of soda. The lower reservoir is also connected to the compressed-air system through a three-way valve *E*, by which the water may be forced from the lower reservoir up into the rheostat tank around the plates *B*, closing the circuit at first through considerable resistance and gradually reducing the latter until the tank is filled. The water then reaches an auxiliary lead plate connected with a local circuit, which works a magnetically operated switch, short circuiting the water rheostat, and at the same time lights an incandescent lamp in the cab notifying the driver that the resistance is all cut out. To stop the motors it is only necessary to open the lower reservoir to the atmosphere through the three-way valve, allowing the air to escape and the water to fall by gravity to the lower tank. The local circuit is first broken, opening the short-circuiting switch, and the



MERCURIC-PNEUMATIC FIELD EXCITING SWITCH.



VIEW SHOWING ARRANGEMENT OF CONTROLLING DEVICES.

resistance is gradually increased until the liquid finally reaches the lower extremities of plates *B*, when the main circuit is finally opened.

In connection with this ingenious system an automatic circuit breaker is also provided. This consists of two electromagnetic relays shown at *G G*, one in circuit with each of the two groups of accumulators in the tender. These relays operate when the current exceeds 1200 amperes, closing a local circuit which energizes a magnetic valve opening the lower tank of the rheostat, allowing the liquid to flow downward, thus interrupting the main current. The controlling apparatus comprises, further, a main switch operated by a handle shown at *H*, which in one positon connects the armature terminals of the motors with the main battery in the tender, and in the other position with the small auxiliary battery in the locomotive itself, which is of sufficient power to drive the machine at low speeds in case of emergency. A series multiple switch is also provided, the handle of this being indicated by the letter *K*. This has three positions, one connecting the two batteries of the tender in parallel with the two motor armatures in series; another the batteries in series and motors in series, and the other the batteries in series and the armatures in parallel. The fields are separately excited from the small battery and controlled by means of four mercury switches, the details of one of which are shown in the accompanying drawing. The mercury is raised and lowered by a plunger shown to the right forced downward by compressed air and restored by a spring, the contact being made in the left hand chamber. The closing of two of these switches energizes the fields in one direction, and the other two in the other direction, to obtain a reverse motion of the locomotive, the armature polarity being under no circumstances reversed. The handle operating the valves is shown at *A* in the sectional elevation of the locomotive, one valve being at *a* and the other at *b*. To prevent one set of mercury contacts being closed before the others have time to open, a magnetic lock *e*, connected in series with the field, holds the lever *A* in mid position when energized.

The various controlling devices described are interlocked in the manner shown in the right-hand drawing of the accompanying illustration. The interlocking is such that whenever the field is excited the three-way valve controlling the rheostat can be moved, but the handle of the main switch throwing in either the main or the auxiliary battery cannot be manipulated. For the operation of the latter the rheostat tank must be opened to the amosphere and the circuit thereby broken at the plates. Further, when the three-way valve of the rheostat is so set as to admit compressed air to the reservoir, neither the reversing mechanism of the field circuit, the series multiple switch nor the battery throw-over switch can be operated.

The indicating instruments consist of three ammeters, one measuring the total currrent in the motor armatures, another the current in the motor field windings, and the other the input of the compressor pump, and four voltmeters one giving the voltage across the motor terminals, two giving the voltage across the terminals of the two main batteries in the tender, and the fourth the voltage of the auxiliary battery in the locomotive.

The storage batteries are of the well-known Fulmen type, brought into considerable prominence by its almost universal use in electric-vehicle work in France. Each plate is enclosed in a box of perforated celluloid, those surrounding the positive plates being internally lined with asbestos cloth. The positive and negative plates in their enclosing boxes are separated from each other by square rods of celluloid. The tanks are uncovered. The batteries differ from those used in automobile work in that solidity and life is not to such a great extent sacrificed for a high output per pound of material. The main battery in the tender contains 192 cells, each having twenty-nine plates, the total weight of the plates of each cell being 175 pounds. Its capacity is 500 amperes continuously for one hour and forty-five minutes.

The locomotive was first used with a smaller equipment of accumulators, but since the addition of the complete battery as described above the following results have been obtained on the main line between Paris and Melun: The maximum load drawn, including that of the tender but not that of the locomotive, was 147 metric tons, which was propelled at an average speed of 30 miles an hour, a higher speed being unattainable on account of the limitations of the storage battery, the required torque necessitating a current so great that the two motors were necessarily kept in series. In running with the motors in parallel there has been obtained with ease a speed of one mile per minute with a load of 100 metric tons, the motors behaving so well that it appears to be possible to run at a much higher speed if only the necessary difference of potential is applied to the armatures. The armatures can carry continuously a current of 700 amperes each, which, at a speed of 500 r. p. m., about 60 miles an hour, would require an electromotive force of 360 volts, the two armatures under these conditions absorbing roughly 500 kilowatts. Estimating their efficiency at 90 per cent., the effective output would be in the neighborhood of 611 horse-power. By doubling the number of driving motors and wheels the full power of standard steam locomotives could be obtained.

A Rumored Corner in Platinum.

The formation of a Franco-Belgian syndicate, with a capital of $10,000,000, has been announced, its purpose being to purchase the platinum mines of Russia and thereby control the world's output of this metal. Ninety per cent. of the world's supply comes from the Ural Mountains, and the consumption is practically a fixed quantity, regardless of price, since wherever platinum is used it is an imperative necessity, so that any change of the supply will have a great effect on the market price. It is claimed, however, that the syndicate has not been able to obtain control of all the mines, so that its plans may not be carried out.

The Open-Conduit Electric Railway in Paris.

N the beauty of the city of Paris the advocates of any system of mechanical traction involving street defacement, such as the overhead trolley, have always found a stumbling block. The requirement of pleasing appearance has caused there the testing one after another of various alternative plans not disfiguring the streets, such as compressed air, accumulator and cable traction. The operation of the open-conduit electric railway systems in this country has naturally been closely watched by the French, and its success here determined its introduction in the city of Paris. The French are thrifty, however, fares are low and the traffic is not what it is in the largest cities of America, so that the general introduction of the open conduit, as in Washington and New York, is considered quite too expensive. One line has, therefore, been opened for service with conductors in an open conduit in the urban district and with the overhead trolley on the outlying extensions, with cars arranged for thorough service with both systems of feeding. The operation of through cars with an interchangeable conducting equipment of this kind is as yet rare in this country, only one small line being so equipped, although it would prove a great advantage in many cities. The best examples of such systems are those in Berlin* and the installation in Paris, described

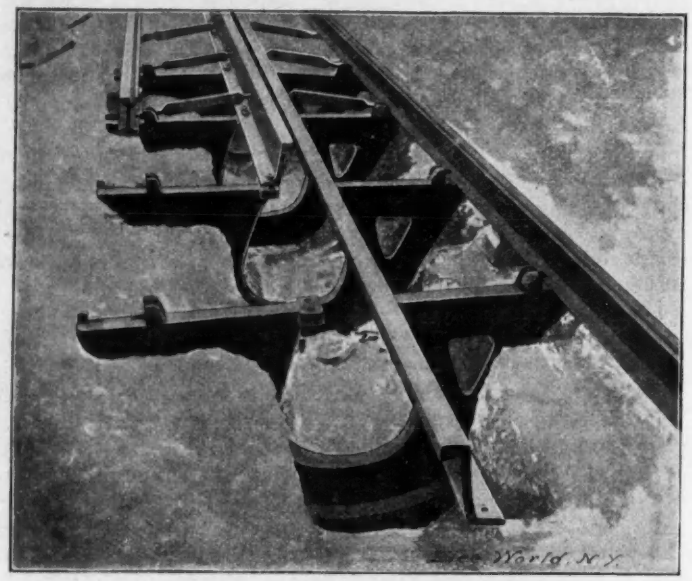


Fig. 1.—The Track Under Construction.

below, the latter being of more interest to Americans than the former in that the apparatus follows largely the standard designs of Mr. F. S. Pearson, which are used by the General Electric Company in this country.

The line is that of la Compagnie Générale Parisienne de Tramways, with a double track from the historic Bastille to Charenton, a distance of about four miles, of which a little over one-half is within the walls of Paris. The tracks are laid with grooved girder rails, weighing 88 pounds to the yard, with cast-welded joints. The minimum grade is 2.6 per cent., and the minimum radius of curvature 100 feet. Of the total length about three miles is supplied by overhead trolley lines, laid out with the greatest care for appearances. The wires are supported on centre poles with short brackets gracefully curved and braced, as shown in the accompanying drawing, Fig. 2. The hangers are supported on short spans to give flexibility. The poles are spaced about 125 feet apart on small islands or refuges in the middle of the street, and each carries two-arc lights bracketed out in line with the track. The lamps are Thomson-Houston 5-ampere enclosed arcs, and run five in series on the railway circuit, but are supplied by special feeders from the power house. Each lamp is provided with an automatic shunt, which, in case of an open circuit, allows the other four to continue burning. The section of the road using the open conduit is, of course, the most interesting, and has been watched with great interest by French engineers and described in considerable detail by the French technical papers, from which the following facts have been taken, credit for most of them and for the drawings being due to "Le Genie Civil." The system resembles closely in most of its points the work of the same nature now standardized in this country, many miles of which are in service on the lines of the Metropolitan Street Railway Company in New York city. The girder track rails and Z-shaped slot rails are bolted to cast-iron yokes, spaced 5 feet 8 inches part centre to centre. The yokes (see Fig. 4) differ somewhat from those used in this country, their outer flanges running straight from the bottom of the yoke to a point under the tram rails. The strain rods are attached to lugs on the yokes, instead of the web of the rail, as in the New York city work. The shape of the conduit differs somewhat also from that in use in this country, its greatest width being quite near the bottom, which is wide and flat,

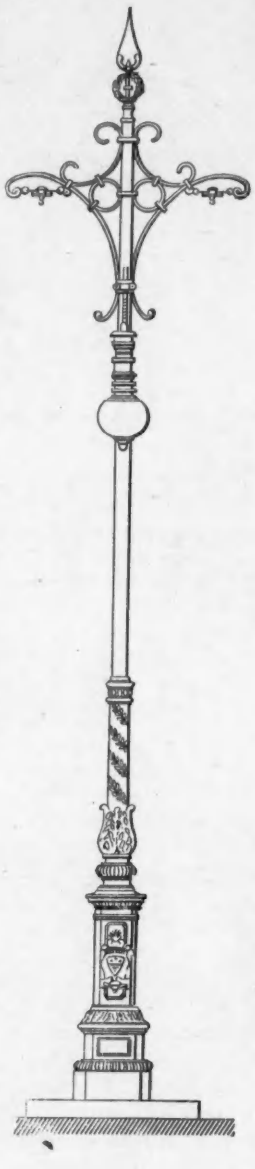


Fig. 2.—One of the Centre Poles.

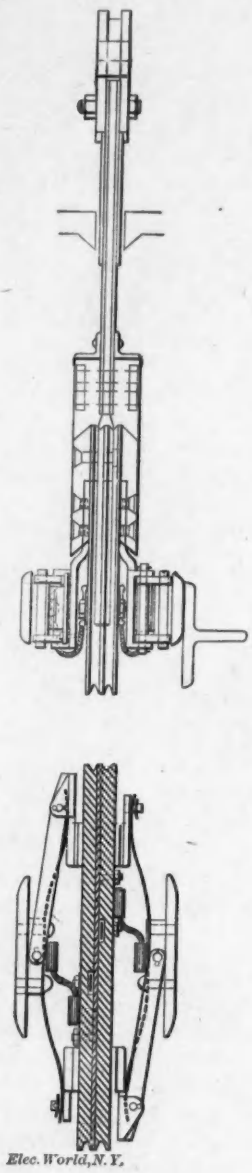


Fig. 3.—Plan and Elevation of Plow.

giving plenty of room for mud and water below the conductor rails. The conduit walls consist simply of concrete 6 inches in thickness, a concrete foundation of the same thickness being laid under the tram rails. The conductor rails are of T section without stiffening flanges at the ends of the head of the T, and are spaced 6 inches apart face to face. They are supported by porcelain insulators cemented into cast-iron caps bolted to the foot flanges of the slot rails, but the insulators are brought more closely to the centre of the track than those in this country, thus reducing the bending moment. The insulators are spaced about 14 feet apart, and are not

*See The Electrical World, October 15, 1898.

mounted in special hand-hole yokes, as in the New York city work, but in recesses or niches of the concrete conduit. Every 100 feet are larger chambers or man-holes branching from the conduit, one of which is shown in the right-hand section of Fig. 4. The hatches of these are filled with paving blocks to conform with the rest of the street surface.

As in this country, the conductor rails are discontinued at switches and crossings. The switches also closely resemble those used here, the switch in the plow slot consisting of a tongue below the street level swiveled to the end of the gusset plate, and attached to the switch lever controlling the track switches, as Fig. 5 clearly indicates. It is noticeable that the switches of both track rails are positive acting.

The mechanism in use at the end of the underground section for removing the plow from the conduit is most ingenious. The arrangement for the same purpose in use in Berlin (described in the article referred to above) involves a plow capable of being folded up into a thickness of less than three-quarters of an inch, so that it may be ejected from the slot without increasing the width of the latter at any point. The Paris system, on the other hand, has what might be called a slot hatch or trap, shown in Fig. 6, consisting of two plates, one on either side of the slot, swiveled in such a way that they can be made to rise and spread, leaving a slot opening 7 inches in width. These plates are shown in the figure in their normal or closed position sectioned and in their raised or open position in outline. They are operated by a hand lever to one side of the track with counter weights on the shaft at the bottom of the man-hole to restore the hatch to the closed position. On the arrival of a car over the manhole the lever is thrown over, opening the hatch, when the plow may be withdrawn vertically without any folding of its parts. The plow (shown in elevation and sectional plan in Fig. 3) carries two cast-iron contact shoes, supported on links, held out by half-elliptic springs and connected with the plow conductors by copper braids. The lower part is of wood, with eaves to shed the water from the terminal plates. The whole may be raised or lowered by a small windlass on the side of the car.

The rolling stock consists of 26-foot single-deck single-truck cars, each fitted with two G. E. 800 motors. The power station contains three six-pole generators, each rated at 150 kilowatts, belted to single-cylinder 220-hp engines. It is necessary, on account of the desirability of supplying the underground line with current from a source, neither pole of which is grounded, to feed the overhead and the underground sections from different machines. As the underground section is short, only about one mile in length, its load is a very unsteady one, and therefore a storage battery rated at 400 ampere hours is connected with it and supplied by one of the dynamos. The storage battery also serves to carry the lighting load through the night, when the cars are not running.

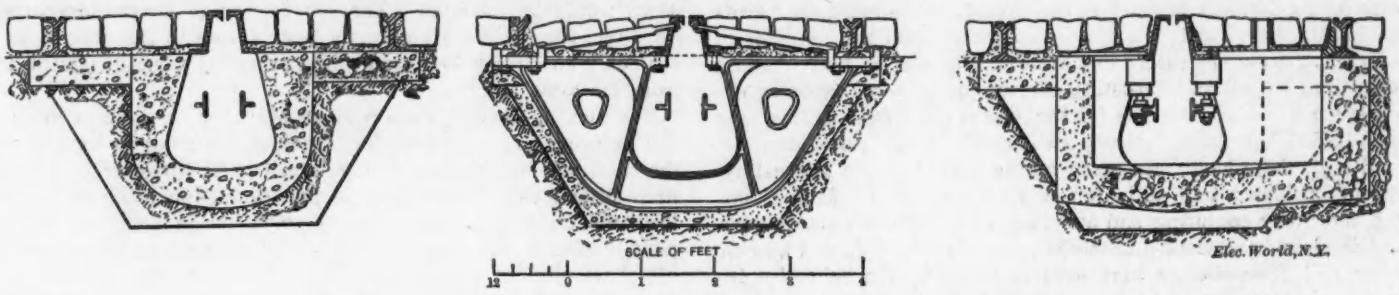


FIG. 4.—CROSS SECTIONS OF TRACK, SHOWING CONDUIT, YOKE AND MANHOLE.

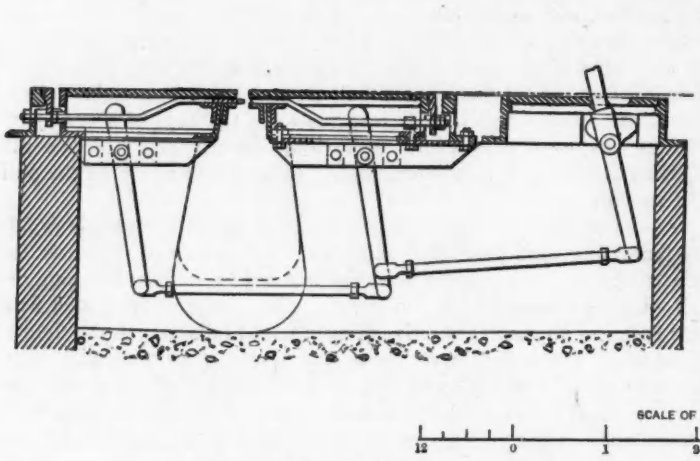


FIG. 5.—CROSS SECTION AT SWITCH.

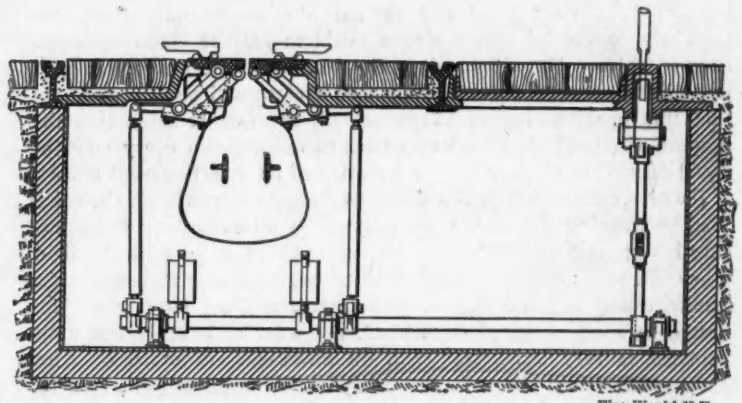


FIG. 6.—CROSS SECTION AT PLOW TRAP.

Another Table of the Telephones of the World.

The Statistical Department of the Swedish Government has made out the following list of the number of telephones in use in various countries the world over. The data are several years behind the times in many of the lands, as the table shows, but are reproduced here for what they are worth. The second column presumably gives the length of the lines in use in the different lands:

Countries.	Instruments in use.	Distance Covered.
United States (1896)	772,627	805,711
Germany (1896)	151,101	147,093
Great Britain and Ireland (1894)	69,645	83,401
Sweden (1897)	56,500	74,568
Canada (1898)	33,500	44,020
Switzerland (1897)	28,846	47,594
France (1894)	27,736	63,230
Austria (1896)	21,616	46,375
Norway (1897)	20,678	33,481
Russia	18,495	40,391
Italy (1896)	11,991	13,049
Spain	11,038	14,282
Denmark (1895)	10,500	9,321
Hungary (1896)	10,293	17,940
Belgium (1895)	9,227	16,235
Mexico (1896)	9,000	11,807
Holland	8,000	4,971
Finland (1895)	7,351	13,049
Uruguay (1896)	3,269	8,117
Japan (1897)	3,232	5,262
Cuba	1,818	1,181
British India	1,601	2,296
Austrailia	823	2,390
Roumania	750	141
The Cape and Natal	600	1,100
Paraguay (1891)	500	625
Philippines	452	592
Algiers	335	224
Bulgaria (1893)	300	372
Tunis	200	281
French India	89	345
Total	1,288,163	1,509,499

The Modern Single-Phase Alternating-Current Motor.

BY T. M. MESTON.

In the days when alternating currents were but dimly understood, and when electricians were struggling with the problem of making a commercial success of single-phase alternating motors, various makers believed that they had found the most perfect motor that could be devised for the new current that had proved itself so valuable as a distributor of light over large areas.

While none of these makers claimed that their motor was equal to the existing direct-current motor, they led the electrical dealer and the consumer to believe that the wares they were offering were practical machines, and as the demand for a good alternating-current motor was large, each successive experiment was seized upon by the electrical dealers, and each one in turn was soon proved to be totally unfitted for practical use.

After a number of these worthless machines had been weighed and found wanting the electrical contractor and dealer came to the conclusion that there was no use trying to get a motor for operation on single-phase alternating-current circuits and registered a vow to have nothing to do with alternating-current motors. This vow has been very well lived up to, and it is almost impossible to approach the average electrician upon this subject. As soon as the phrase "Alternating-Current Motor" is mentioned, he immediately "girds him for the fray," and tells a story of the days of toil, number of dollars and good customers that were utterly lost by him when he endeavored to sell an alternating-current motor some years ago.

It is hard to blame anyone for looking at the matter in this light when he has had the experience mentioned, but the world does not stand still; there have been many minds working upon alternating-current problems, and, although there were many difficulties met with and many confusing and apparently contradictory phenomena, all difficulties have yielded to modern engineering skill, and all confusion and contradiction have been removed by the help of a few master minds in the field of theoretical electricity, who worked out the fundamental laws governing the alternating current. After the primary laws were fixed and certain the production of a commercially successful motor was a problem for the electrical engineer to solve. Notwithstanding the fact that nine out of ten well posted and successful contractors and dealers will stoutly maintain that this problem has not been solved, the fact remains that the modern single-phase alternating-current motor is in every way the equal of and in many ways the superior of its direct-current cousin.

These modern motors are made so that they start with their full load by running them for a few seconds as series motors, the armature being connected through a commutator in series with the field. They do not need any starting rheostat, and as the brushes are automatically raised from the commutator and the latter short circuited as soon as speed is reached, the wear of brushes and commutator is very much less than on direct-current motors. After they reach speed there is absolutely no wear on any part of the machine except the bearings, and as the armature is entirely disconnected from the field there is little danger of "burn outs."

The efficiency of these machines is very high, the writer having recently seen the test sheet of a 1-hp motor showing an efficiency of 80 per cent. on 104 volts, 7200 alternation current. This is a very high efficiency for a motor of this small size, even on direct current. These high efficiencies are only possible on low-frequency circuits, although motors as small as one-half horse-power are regularly made for 133-cycle current, with efficiencies of from 65 to 75 per cent. Alternating current can be procured in almost any part of every city or town of over 5000 inhabitants in this country, and there are dozens of people in every town of the size mentioned who can use power in larger or smaller units. These possible users, however, know nothing about the merits of electric power, and if they ask their electrical dealer, he immediately says that undoubtedly electric power would be more flexible, more easily handled and much cheaper provided that the direct current could be procured, but that the central station in that town furnishes only alternating current, and that alternating-current motors won't work and are an all-around nuisance.

This is a sad condition of mind for the wide-awake dealer to be in because, as a matter of fact, the modern alternating-current motor is exactly the machine that should be placed in the hands of users new to electrical power. The machine is extremely simple in operation and will stand an amount of neglect and abuse that would send the direct-current motor to the repair shop. If it is oiled occasionally, the commutator cleaned about once a month, and a new pair of carbon brushes put on about twice a year, it will attend to its own business and prove a source of joy to the owner, and will be a standing advertisement to all the community that the electrical dealer who installed it was up to date and was to all intents the discoverer of a new power for use in his town.

As an evidence that the above is not what an army man would call "wind jamming," the writer will say that several of these machines have been used by the Post Office Department for over two years on what is probably the hardest service a motor can be put to: that is, operating cancelling machines. These machines are in almost constant use for the entire twenty-four hours and are used every day in the year. One large alternating-current central station is discontinuing its direct-current power circuit within a certain district, replacing all direct-current motors, both large and small units, with alternating-current motors, and the experience of this station proves that its customers are better satisfied with and have less trouble with the alternating-current motor than with the direct-current motors formerly used. This station has even gone so far as to operate the entire plant of a large morning newspaper in a city of over 500,000 inhabitants by means of alternating-current motors. If the motors were an experiment, you can easily imagine that a daily newspaper office would be the last place where a breakdown would be tolerated. The substitution of alternating-current for direct-current motors means a large saving to this station, as it enables it to furnish light and power from the same generator and from the same circuits.

For users of very small powers an even simpler type of machine can be procured, one which has absolutely nothing to wear except the shaft and bearings, having no small parts whatever to wear or need adjustment. This type is a pure induction machine with no insulated copper on the revolving part; but in common with all pure induction machines, it has little or no starting torque on single-phase circuits. For this reason this type is not recommended in sizes larger than one-fourth horse-power. In such small sizes the fact that it is not self-starting is of no moment, as a slight pull on the belt will enable the motor to pick up the load in a few seconds; even this slight trouble can be avoided by allowing the motor to start up without load, and throwing the load onto the motor by a friction disc, or by shifting the belt from a loose to a tight pulley. In actual practice this is only resorted to in the case of a very particular customer who wants everything exactly so, most people finding that it is a very simple thing to give the belt a slight pull on starting.

As the number of firms engaged in the electrical business is rapidly increasing each year they must find new users and new uses for electricity or the volume of business will not be sufficient to support all who are engaged in it. While there is a large undeveloped field for eectrical power in the cities of over 50,000 inhabitants, the field is absolutely untouched in the cities and towns of smaller size. Can anyone name a single town of 10,000 inhabitants where a day load of 100 horse-power cannot be easily obtained? There are in every town small factories, such as machine shops, blacksmith shops, carpenter shops, printing offices, etc., etc., which are running small steam engines, and which can be supplied with power by the central station more cheaply than they can make it themselves and still leave a handsome profit for the central station.

With a few of the larger users started, additions can always be made of smaller users. Every town has a number of fine residences whose owners pump water from wells to tanks in the attic, and in that manner obtain the advantages of city water supply. Direct-connected electric pumps are more suitable for this purpose than windmills, besides being less unsightly and requiring less of an investment.

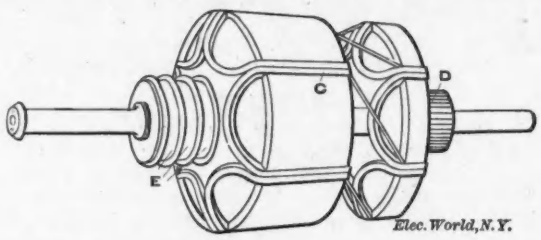
There are many other means of using alternating-current motors in every town, and the writer hopes that some of the dealers and contractors will overcome their old prejudice against alternating-current motors sufficiently to enable them to look into the matter once more in an unbiased frame of mind, as he is fully convinced that such an investigation will fully prove the truth of the facts mentioned above, and will also convince them that there is a large opportunity for increased business and profit which will be captured mainly by those dealers and contractors and central stations who first learn and become convinced that the modern alternating-current single-phase motor is a reliable machine, which will be a source of satisfaction and profit to all connected with its installation and operation.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

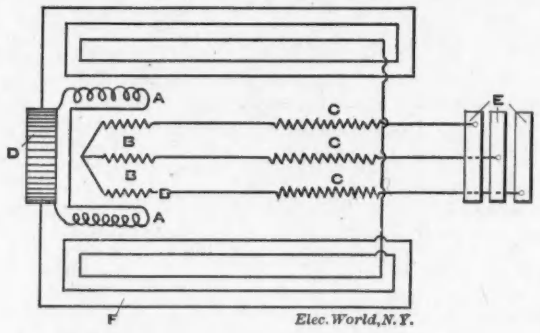
COMPOUND WOUND ALTERNATORS.

A method of compounding alternators, differing somewhat from those recently described, is explained by the inventor, Danielson, in the "Elek. Zeit.," Jan. 12, accompanied by illustrations of the complete machine and the results of tests made with it. In an introduction to the description he calls attention to the fact that regulating the voltage of alternators by means of resistances is much more difficult than in the continuous-current system, and that the phase-shifting in installations is a very changeable one, which adds to the difficulty of regulation. To avoid variations in the voltages it is necessary to construct alternators so that the voltage is affected as little as possible by the armature reaction and self-induction; but this involves new difficulties, as generators which are constructed for a minimum loss of voltage become very heavy and expensive, and have a lower efficiency; the compounding of alternators is therefore of even more importance than with continuous-current generators. His method of compounding consists in placing an additional winding on the armature of the exciter, connecting it either in series with the main alternating current through the usual slide rings, or passing through it a proportional current obtained by means of a transformer. The exciter must have such a speed that the frequency is the same. The alternating current is led into the exciter armature winding so that it will act on the field of that exciter, strengthening it in the same proportion as the phase shifting in the main current increases, and as the current in the main circuit becomes stronger. The simplest solution is to place the exciter armature on the shaft of the alternator. The alternating-current coils in the two armatures are so connected that the current passed in the opposite direction, so that the reaction of the armatures on the fields is opposite—that is, when the generator field is diminished the field of the exciter is increased and vice-versa. As the armature reaction is proportional to the sine of the inner phase shifting, and the latter is the same in both armatures, but of opposite signs, it follows that for every current and phase shifting the reaction of the two fields can always be made proportional. If, therefore, saturation of the iron is avoided, it must be possible in this way to provide a compensation, both for the current strength and for the phase shifting. The adjoining illustration shows how



Elec. World, N.Y.

the main winding is connected with the compensating winding, while the diagram below shows the connections between the various circuits. Tests show that the best compounding is not with a phase



Elec. World, N.Y.

shifting of 180°, but that the best angle was about 170°. The relative shifting of the two armatures is not theoretically complete, but the results were nevertheless quite good. A diagram gives the voltage curve for different currents, one with and the other without the compound winding for a nearly inductionless load; they show a very good compounding. Another pair of curves for inductive load, in which the phase shifting in external circuit was about 37°, is also given, and shows that the voltage remains nearly constant, though not as good as in the other; the loss of voltage at full load was about 6 per cent., but this is small as compared with the large difference for constant excitation. It appears that by a modification of the winding, involving several alternate-current windings on the exciter armature, so that the angle of 170° may be increased to 175°, complete compensation could be reached. Such a compounding involves a large saving in material in the construction of the alternator and an increase of the efficiency. The compounding of alternators is of much more importance than in continuous-current machines, because in the latter a certain variation in the current as a rule produces a much smaller drop in voltage than in the former.—Danielson. "Elek. Zeit.," Jan. 12.

REFERENCES.

Electric Generators.—In this continuation of the authors' long serial they give very full data and good drawings of a ten-pole light generator for 300 kilowatts, 125 volts, 2400 amperes and 100 revolutions, built by a large German company. Information on the saturation, compounding, core loss and efficiency is given; carbon brushes are used, notwithstanding the low voltage and large current.—Parshall and Hobart. Lond. "Engineering," Jan. 13.

Designing an Electric Launch Motor.—A long, detailed description, with numerous illustrations, showing how to design a motor for a boat about 24 feet long, 4 feet 6 inches beam, drawing 18 inches and having a speed of 7 miles an hour. The motor drives directly without gearing, and the energy is obtained from storage batteries.—Child. "Sc. Am. Sup.," Jan. 14.

Alternating-Current Motors.—Some views of the exterior of a number of alternating-current motors, accompanied by brief descriptions, as made by the successor to the Schuckert Company, of Nuremberg, Germany.—"Sc. Am. Sup.," Jan. 21.

Machine Work on Large Pieces.—An illustrated description of some of the methods used at the Westinghouse works for planing, shaping, etc., very large pieces for electrical machinery.—"Amer. Mach.," Jan. 19.

Designing a Small Welding Transformer.—The first part of an article giving practical directions, accompanied by working drawings, for constructing a transformer to be used in work shops.—Hanchett. "Amer. Mach.," Jan. 19.

Effect of Commutation on the Field of Dynamos and Motors.—An abstract, with illustrations, of the article noticed in the "Digest" last week.—Everett and Peake. "West. Elec.," Jan. 21.

Care and Construction of Commutators.—A reprint of the article noticed in the "Digest" Nov. 12.—Matthews. "St. Ry. Rev.," Jan. 15.

Rotary Converters.—The beginning of a reprint of the long paper abstracted in the "Digest" Dec. 3, 10, 17, 24.—Thompson, "St. Ry. Rev.," Jan. 15.

Repairing Electrical Machinery.—Some brief, illustrated hints.—Fells. "West. Elec.," Jan. 21.

Lights and Lighting.

ALTERNATING-CURRENT ARCS.

A number of years ago Professor Blondel published his investigations on the principal properties of the alternating-current arc, and he has now verified these by using his oscillograph, which was described a number of years ago, and which indicates at every instant of the period the variable value to be determined. A report of the recent experiments is published in "Comptes Rendus," 127, p. 1016, an abstract containing eighteen of the curves being given in "L'Eclairage Elec.," Jan. 7. These curves give the current in the arc, and the difference of potential between the points of the carbons and their relative phase difference, the curves being laid off on a horizontal axis representing the time. These results are claimed to verify perfectly those of his preceding researches and enable the same conclusions to be drawn, more especially the following: The phenomenon of the alternating arc can be quite different according to the circumstances, and there would be an almost infinite variety of curves, a few of which are reproduced. The essential factors, however, are the nature of the carbons—that is, whether homogeneous or cored—and the nature of the circuit—that is, whether inductive or non-inductive. The only carbons which give rise to a perfectly defined phenomenon, which he calls the normal arc, are the pure homogenous carbons, containing very little of the mineral salts, cored carbons giving very indefinite results. For the homogeneous carbons the effect of the nature of the circuit is most clearly defined, and as the circuit is non-inductive or strongly inductive, there are obtained two types of characteristic curves, which are very different and which are explained by the phenomenon of vaporization and the disruptive tearing away of the carbon. The great difference between the non-inductive and the inductive circuits is that in the latter the retardation of the current behind the e. m. f. produced by self-induction, enables the voltage to quickly rise to a value after each change of sign, for lighting the arc in the reverse direction, while in non-inductive circuits, and especially if the arc is hissing, the difference of potential follows during the extinction the rounded curve of the e. m. f. of the source. The addition of a core to the carbon, formed of powder mixed with silicates or similar substances, changes the conditions completely by the production of vapors of the conducting salts; these tend to make the curve approach the simple sine form or rounds them off as though the arc was only a dead resistance.—Blondel. "L'Eclairage Elec.," Jan. 7.

TRANSFORMING THE ENERGY OF CATHODE RAYS INTO LIGHT.

It is often thought that luminescent bodies generate light very economically, as the energy radiating from them is a maximum for the visible part of the spectrum, and quite small in the red or infra red part; it is supposed that, therefore, very little energy is changed into heat. The real question, however, is how much of the energy in such processes is changed into light, and it was to determine this that Professor Wiedemann made tests described in the "Ann. d. Physik u. Chemie," Vol. 66, p. 61, a brief abstract of which being published in the "Zeit. f. Beleucht.," Jan. 10, and "L'Eclairage Elec.," Jan. 7, the latter containing an illustration of the tube. Some years ago this question was investigated by him for the phosphorescent light of the Balmain luminous paint, and for the fluorescent light of a solution of fluorescine, and he found that only one-three-hundredth to one-fiftieth of the energy of the existing light was contained in the energy radiated from these bodies; the rest of the power must therefore have appeared in the heating of the body or in the chemical processes. Recently he made experiments to find the percentage of the energy of cathode rays which reappears as light. He used a vacuum tube connected with a mercury pump, and having two strips of tinfoil at two diametrically opposite parts, between which the discharge takes place. A tube closed at the inner end was fused into the glass, and contained a certain amount of water, into which a thermometer was introduced; the closed end of the tube was in the path of the rays, and was covered with Balmain's luminous paint. The light rays radiating from the luminescent surface were measured by the photometer. The greatest brightness was one-twentieth of a Hefner candle at a production of heat equal to 0.05 gr. calories per second, or, in other words, one candle corresponded to one gram calorie per second; the best result obtained was 0.62 gr. cal. per minute. According to Tumlirz, the total energy radiated from the amyl acetate lamp is 0.189 watt, from which it follows that with 1 horse-power the 3890 Hefner candles could be generated. Comparing this with the figure above given, it is seen that only one-twenty-secondth, or, at most, one-fourteenth of the energy of the cathode rays is changed into light, and that the efficiency is therefore only 5 to 7 per cent. Moreover, this is only the efficiency of the conversion of cathode rays into light, and does not include the losses in the production of the cathode rays. A paper on a similar subject was noticed in the "Digest" Sept. 24. —Wiedemann. "Zeit. f. Beleucht.," Jan. 10; "L'Eclairage Elec.," Jan. 7.

REFERENCES.

Arc Lamps on Incandescent Lamp Circuits.—An abstract, with illustrations, of a recent paper on the connection of continuous-current lamps, three in series, on 110 to 120 volt mains, and on a new alternating-current lamp.—Weil. "Elek. Zeit.," Jan. 12.

Power.

WATER-POWER PLANT AT PADERNO.

The concluding portion of the long translation of Semenza's description (see "Digest" last week) of this interesting plant, published in the Lond. "Elec.," Jan. 13, refers to the switchboard, lines and accessories. The switchboard, which is illustrated diagrammatically and briefly described, is claimed to be one of the most remarkable parts of the plant. The principle of a quick break in oil is used in the high-pressure switches. The fuse wire is stretched in an open tube of composition or porcelain, the arc formed expanding the air in this tube, causing a kind of explosion which extinguishes the arc. A wattmeter is inserted on the switchboard panel of each dynamo to give a true relative indication of the load on each alternator, as distinguished from an absolute reading, because when several alternators are in parallel the ammeters give very little indication of the true load on the machines, on account of the phase difference. Electrostatic voltmeters at the generating station measure the pressure at the receiving end by means of pilot wires, and the pressure is regulated according to this reading. Special care was taken to avoid breakdowns in the lines by adopting a very strong construction and arranging it so as to make repairs easy; for the latter reason there is a double row of posts, each carrying half—that is, nine of the wires; when it becomes necessary to work on one of these lines, all the others on the same line of poles can be cut out of circuit, the supply being carried entirely by the others, provision being made to raise the voltage to 15,000 for overcoming the additional line loss. Theoretically the best arrangement of a number of conductors carrying three-phase currents would be that in which each conductor is placed in the same condition of induction with respect to the others; a cross-section should show all of the wires placed at equal distances on a circle, but as this is not practical, the next best arrangement for giving the smallest mutual induction between the different wires of the same branch was adopted, and in this the different wires of the same group are arranged in the form of a triangle, the distance between them being 2 feet. The calculation of the loss of pressure is more complicated than with continuous currents; the case was carefully studied by the late Ferraris, and the resulting calculation is said to be of the highest interest; the result of it is that the drop of pressure is about 12.5 per cent., while the loss of energy is only 9 per cent. This line is said to be one of the first in which entirely metallic masts are used. The insulators are to be partly of the American bell type, made in Italy, which has an internal core of glass or hard porcelain, and the other the multiple umbrella type, made entirely of porcelain. It was decided to use one of the types on one line and the other on the other line, in order to obtain the much-needed experimental data. Lightning arresters and their functions are then discussed at some length, but he appears to give nothing new. Among other things he states that a barbed wire running along the whole line on the top of the poles, and earthed occasionally, has given negative results in other places, for which reason it is no longer used in Europe; while it may protect against direct discharges, it does not protect against secondary effects. He agrees with Wurts in that a great number of lightning conductors must be placed along the line, as they should be near one of the nodes of the electrical oscillations, the location of which is uncertain. He does not consider that any difficulty is involved in protecting the machines and transformers. Concerning earth plates he says that moist earth is very good, but water itself bad. The lightning arrester should have a high ohmic resistance, with a small coefficient of self-induction, as, for instance, for a carbon rod. It is absolutely necessary to have separate earths for each lightning arrester, because joining all into a single one is very dangerous, as it makes the ultimate resistance of the short circuit practically zero. The best results so far obtained have been with the Wurts and Siemens types of arresters, both of which are briefly described; the latter is the well-known form in which the two conductors have the appearance of two horns, the arc being extinguished by electrodynamic effect. In order to obtain reliable experimental data both these types have been installed in this plant, to decide which is the better. A footnote states that this plant was started last September or October, and that the high tension worked perfectly, the dynamos giving the guaranteed efficiency and the line losses being exactly as calculated.—Semenza. Lond. "Elec.," Jan. 13.

Another description of the line itself was noticed in the "Digest" Dec. 3.

REFERENCES.

Refuse Destructor at Shoreditch.—A brief review of the first year's work of this electric lighting plant, the power for which is obtained by burning the city refuse. The subject is also discussed editorially, the difference between the refuse in that country and this being pointed out. It is also stated editorially that thus far thermal storage has not been a success, and that there are at least slight indications that it will never be successful.—"Eng. News," Jan. 26.

Alternating-Current Transmission and Distribution.—The paper noticed in the "Digest" Jan. 7 is continued at great length in the "Bul. Soc. Int. des Elec.," Dec. A small portion of the apparatus discussed was described in The Elec. World Jan. 14, p. 58.—Leblanc. "Bul. Soc. Int. des Elec.," Dec.

Power of Wood Saws.—Some useful data showing how much power is required for operating various saws under different conditions.—Dodge. "Sc. Am. Sup.," Jan. 14.

Stage Appliances at the Drury Lane Theatre.—A reprint of the article noticed in the "Digest" Jan. 21.—N. Y. "El'ty," Jan. 25; N. Y. "Elec. Eng.," Jan. 19.

Polyphase Transmission of Power.—A reprint of the article noticed in the "Digest" Dec. 31.—Wallis. "West. Elec.," Jan. 21.

Traction.

ELECTROLYSIS OF WATER MAINS IN BROOKLYN.

The "Eng. News," Jan. 26, refers briefly to the recent bursting of a 4-foot water main in Brooklyn, accompanied by a large amount of damage and the cutting off of the water supply from a large area. It is said that there is unmistakable evidence of electrolytic action displayed by this broken section. Moreover, the place where the break occurred is in the vicinity of an electric railway power station. An illustration is given of an 8-inch water main which was recently taken up, and which shows the effect of electrolysis in thinning the iron pipe; it is considered to be a piece of circumstantial evidence on the causes of the break in the 4-inch main. Some extracts are quoted from a report by the expert of the National Board of Fire Underwriters. In this it is said that the imperfect construction of trolley roads is causing slowly but surely the destruction of the water and gas service throughout the country. Attention is called to the possibilities of a fire occurring after such a break occurs as that one in Brooklyn. It is claimed that the destruction of pipes can be prevented by several methods, the most perfect being to compel the overhead trolley to be replaced by the underground conduit system, in which the complete metallic circuit is used, as in the New York lines of this kind. But as this would involve undue expense, the companies should at least be compelled to immediately rebond their roads and run feeders having a conductivity and capacity in proper proportion to the greatest amount of current that may be required at any one particular time; "they certainly should not be permitted to humbug the authorities in the matter of bonding as they do in the majority of cases."—"Eng. News," Jan. 26.

REFERENCES.

Determining Speeds and Regulating Resistances for Electric Cars.—The first part of a very long article describing a graphical method for determining the speeds of electrically driven vehicles and the resistances to be inserted in circuit with the motors. The diagram seems somewhat complicated. One of the conclusions which he arrives at is that only powerful motors, developing high starting torque, should be used, and that they have the advantage when compared with weaker motors, of requiring less current for the same power.—Neidt. "Elek. Zeit.," Jan. 12.

Railway from Fayet to Chamounix.—A brief description of this one metre gauge line, 38 kilometres in length; the power is obtained from waterfalls. The gauge, in some places, is 8 to 9 per

cent., and in order to avoid a rack only motor cars are used, the adhesion of which is sufficient on the grade of 9 per cent.—"L'Eclairage Elec.," Dec. 31.

Acceleration on Light Railroads.—The conclusion of the article noticed in the "Digest" Jan. 14. In it the author discusses the subject of acceleration, in order to show the dangers of using formulas without a knowledge of their limitations.—Wood. "Railroad Gazette," Jan. 13.

Rack Railway from Barmen.—A brief, illustrated description of this short line in Germany, the mean grade of which is 1 to 9.5 and the maximum 1 to 5.4; the length is 1630 metres, and the rise 171 metres.—Zerner. "L'Eclairage Elec.," Dec. 31.

Central London Railway.—A brief, illustrated description reprinted from the London "Engineer" of the electrically driven excavator used in making the tunnels for the Central London Underground Railway.—"Sc. Am. Sup.," Jan. 14.

Mixed System.—The reprint of the complete paper, an abstract of which was noticed in the "Digest" Dec. 31.—de Marchena. "Bul. Soc. Int. des Elec.," Dec.

Boston Terminal Station.—A well-illustrated description of this station, in which electric traction is ultimately to be used.—"Sc. Am.," Jan. 14.

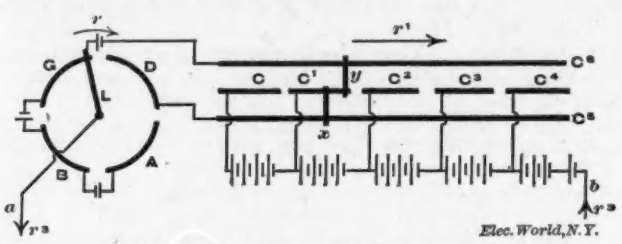
Carlisle and Cork.—Brief, illustrated descriptions of these stations, taken from the English papers.—N. Y. "Elec. Eng.," Jan. 19.

Cork.—An illustrated description.—"St. Ry. Rev.," Jan. 15.

Installations, Systems and Appliances.

ACCUMULATOR REGULATING DEVICES.

In order to reduce the cost of the numerous copper connections running from the regulating cells to the switches, Messrs. Heath and Field have devised a system, an illustrated description of which is given in the Lond. "Elec. Eng.," Jan. 13, which is quite similar to the one described and illustrated in the "Digest" last week. The principle of the apparatus is that only a few cells are used for the small adjustments, while a number of groups, containing the same number of cells, are used for large changes. The switch described is for twenty regulating cells, and consists of two sets of contacts on the two faces of the slate, geared together so that as the connections are changed from one group to the next the three separate regulating cells are connected to the one switch are switched in series with the incoming terminal of the battery, so that they may be



Elec. World, N. Y.

again cut out individually. The adjoining diagram shows this, the one switch to the left cutting out three cells separately, while the switch to the right cuts out groups of four. For twenty steps only nine cables are required, or for thirty-six steps thirteen, and the resulting saving in the expense of the cables under the ordinary conditions can easily exceed $500.—Lond. "Elec. Eng.," Jan. 13.

REFERENCES.

Vienna.—A very long, illustrated description of the central stations of one of the companies in Vienna, in which the five-wire system is used, together with accumulators.—Kolbe. "Zeit. fuer Elek.," Jan. 1 and 8.

Hotel Plant.—A brief, illustrated description of the mechanical and electrical equipment of the Union Hotel, Chicago.—"West. Elec.," Jan.

Wires, Wiring and Conduits.

REFERENCES.

Concentric Wiring.—A short communication calling attention to his system, which he claims makes it impossible to maintain absolute security against fires and dangerous shocks in buildings where currents, such as those from trolley circuits, are used; he also claims that his system is decidedly more available than the European one, as the inner conductor is removable, thus making it accessible. —Kintner. N. Y. "Elec. Rev.," Jan. 25.

Alternating-Current Distributing Mains.—A translation in abstract of his article, noticed in the "Digest" Jan. 7.—Andriessen. Lond. "Elec. Eng.," Jan. 6.

High-Tension Cables.—A long abstract of a recent article in the Lond. "Engineer," referring chiefly to cables made in England.—"Elek. Zeit.," Dec. 22.

Electro-Physics and Magnetism.

STEEL FOR PERMANENT MAGNETS.

Some time ago most elaborate researches were made by Mme. Curie of the properties of various kinds of steel for permanent magnets. The results were published in the "Bull. de la Soc. d'Encouragement pour l'Industrie Nationale" for Jan., 1898, an abstract of which was noticed in the "Digest" Aug. 20. The Lond. "Elec. Rev.," in its issue of Jan. 13, begins the publication of a long translation in abstract of this paper, including some of the more important tabulated results. A brief editorial discussion is also given in this number. She experimented with about forty-seven different kinds of steel, including ordinary carbon steels having different percentages of carbon and a number of others containing chromium, copper, nickel, manganese, tungsten and molybdenum. It does not appear that she made any new departure or any particular discovery, but the information appears to be more extensive, varied and exact than anything previously published on the subject. As a general result she found three kinds of steel specially suitable for magnets. She confirms the high character of the well-known Allevard steel, which contains 0.59 per cent. of carbon and 5.5 per cent. of tungsten; but finds that a steel containing 1.7 per cent. of carbon and 4 per cent. of molybdenum instead of tungsten possesses still higher qualities. One of the most important points in the construction of magnets is a careful regulation of the hardening temperature, which should not exceed a certain moderate limit. It appears also that such a careful regulation of the hardening temperature should be as important for the mechanical as for the magnetic properties of the steel.—Curie. Lond. "Elec. Rev.," Jan. 13.

NEW SOURCES OF BECQUEREL RAYS.

A new metal, whose chemical reactions are those of barium, is claimed to have been discovered by P. and Mme. Curie. In a paper by them in "Comptes Rendus," No. 26, abstracted briefly in the Lond. "Elec.," Jan. 13, and "Sc. Am.," Jan. 28, they show that the radio-activity of the chloride of this new substance, mixed with barium chloride, measured by its power of imparting an electric conductivity to air, is about sixty times that of metallic uranium, and after repeated precipitations with alcohol it becomes 900 times more effective. The most important discovery is said to be that this substance and the one they call polonium are capable of producing photographic impressions in half a minute, instead of in several hours, like uranium and polonium, and that, like Roentgen rays, they are capable of exciting fluorescence on the platino-cyanide screen. Here we have apparently a source of light requiring no supply of energy to maintain it.—Curie, Mme. Curie and Demont. "Comptes Rendus," No. 26; abstracted briefly in Lond. "Elec.," Jan. 13, and "Sc. Am.," Jan. 28.

PRINTING BY X-RAYS.

A description in detail of a process of printing by using X-rays, which is claimed to be faster than any conceivable method now used, is given by Dr. Kolle in the N. Y. "Elec. Eng.," Jan. 19. The process is claimed to overcome the cost and labor of composition, is said to require very little time for making the copies, and has the advantage that the entire matter may be kept a secret from the printer. Some inks to be used are described. A pile of sensitive paper is made with the original copy on top and is then exposed to the X-rays, after which the sensitive sheets are developed. It is thought that an exposure of ten to twelve seconds would be sufficient. With blocks containing fifty sheets, twenty blocks being arranged around one tube, 1000 copies could be printed in ten seconds' exposure, or 6000 copies per minute for each tube. During eight hours one man could make 250 exposures corresponding to 750,000 copies per day per man. (It appears that the process described is only a suggestion which has not yet been tried.)—Kolle. N. Y. "Elec. Eng.," Jan. 19.

ROENTGEN RAYS.

A few more of the numerous notes on what he calls Roentgen light, by Mr. Rollins, are published in N. Y. "Elec. Rev.," Jan. 25. When a discharge tube was cooled by being placed in oil he noticed that at the anode end the oil fairly boiled, but only in appearance, as its temperature was not raised to the boiling point; the surface was raised and was in constant motion, but no bubbles were formed. When the tubes were removed and the terminals placed 15 inches apart, the phenomenon was very marked, the surface of the oil near the anode being raised a quarter of an inch. He calls this a liquid brush discharge. He discusses the theory of the burning produced by Roentgen rays. He compares tubes containing hydrogen and oxygen and discusses the question of harmonics, calling attention to the imperative necessity for the existence of these harmonics in a generating current if it is desired to convert economically a long into a short vibration.—Rollins. N. Y. "Elec. Rev.," Jan. 25.

REFERENCES.

Electric Valves.—Judging from the recent inquiries received by the compiler, the subject of so-called "electric valves" (apparatus which allows a current to pass in one direction and not in the other) is exciting some interest. As the references to articles on this subject are scattered under different headings, they are not easily found, and the following list has therefore been prepared covering the "Digest" notices for the past year and a half. This list is thought to be complete for that period. Notices bearing on this subject directly or indirectly were given in the "Digest" as follows: In 1897, July 17 (Pollack); Aug. 14 and 21 (Graetz); Aug. 21. In 1898, Feb. 12 and 19; March 12 and 19; May 28; June 25; July 30; Aug. 6, 13 and 20, and Oct. 1 (Wilson); Aug. 20; Nov. 5; Dec. 10 and 17. In 1899, Jan. 14, 28 and Feb. 4.

Action of the Current on Photographic Plates.—A short, illustrated article in which he describes experiments showing the similarity of certain chemical reactions with those produced by electric currents and magnetism on dry photographic plates.—Jahr. "Elektrochem. Zeit.," Jan.

Dielectric Constant and Electrical Conductivity of Liquid Ammonia.—An article giving the results of determinations.—Goodwin and Thompson. "Phys. Rev.," Jan.

Nickel Steels.—An abstract of a French Physical Society paper on the anomalies of this alloy and the causes of the residual deformation. He describes some new properties of the alloy.—Guillaume. "L'Elec.," Jan. 7.

Converse of the Zeeman Effect.—A note stating that the converse of the Zeeman effect should exist; experiments are being made to prove it.—FitzGerald. Lond. "Elec.," Jan. 13; reprinted from "Nature."

Meteorological and Magnetic Phenomena.—An article on the analogy of some irregularities of the yearly range of meteorological and magnetic phenomena.—Van Rijckevorsel. "Phil. Mag.," Jan.

Electro-Chemistry and Batteries.

ELECTROCHEMICAL AND ELECTROMETALLURGICAL INDUSTRIES IN 1898.

What appears to be a good summary of the present state of some of these industries is given by the well-known writer on these subjects, Mr. J. B. C. Kershaw, in the Lond. "Elec. Rev.," commencing with the issue of Jan. 13. The year which has just closed has not brought forth any strikingly new progress in the industrial process; one important process, the Ashcroft zinc-recovery process, has been virtually abandoned, one important patent case, that of Castner-Kellner and Rhodin, has been decided in favor of the former and a process which may become important, namely, the Swinburne sulphide ore process, has been brought before the public. But there has been a steady advance in the processes which are operated on a commercial scale; their progress has been satisfactory, and in some cases phenomenal. In the discussion of the alkali and bleach processes he states that the Castner-Kellner is developing most rapidly; the Richardson and Holland process is not such a success as the promoters had hoped, while the Hargreaves-Bird process is still working satisfactorily on a small scale at Farnworth; the Hulin (fused salt) process is in operation at Savoy. The other works are briefly mentioned; no correct estimate of the total output can be made; the Castner-Kellner works are now producing 2500 tons of caustic alkali and 5500 tons of bleach per year, and this will be doubled. The works at Bitterfield are said to be producing 14,000 tons of bleach per year. Borchers, in 1897, estimated that the German companies were decomposing between 15,000 and 20,000 tons of potassium chloride per year, and this will probably be exceeded during the present year. A list of the places where such works are in operation is given. Concerning aluminum he states that its manufacture and utilization is slowly but steadily growing. The total output in 1897 was estimated to be 3400 tons, which will probably be exceeded by a few hundred tons for the past year. The only works in Great Britain are at Foyers, which produced 300 tons in 1897, as against 1814 tons by the works at Niagara. The Peniakoff process, a new one, has reached the industrial stage, and is now being operated in Belgium; aluminum sulphide obtained by reduction of the sulphate is used in place of the oxide, but the writer does not consider the process a very promising one. The existing eight works which he mentions have an aggregate power of 20,000 horse-power available, and could produce about 25,000 pounds per day. The calcium carbide and acetylene industry seems at present to be the most successful of all, judging from the activity of the inventors and promoters, but he does not consider that this activity is justified either by the present or the prospective demand for the carbide; acetylene can have but a limited field of usefulness. The number of works were greatly increased during the past year, and a list of them is given, the total being thirty-two, besides nineteen in course of erection.—Kershaw. Lond. "Elec. Rev.," Jan. 13.

NOTES ON ACCUMULATOR CONSTRUCTION.

In this continuation of his long serial the author discusses briefly the various methods of charging. The constant power method appears plausible from the standpoint of coal consumption, but from the electrochemical point of view it is a fallacy. This method is practically the same as charging with constant current, an unscientific system which he thinks should be relegated to ancient history. The object should be to economize time by charging under high-current density during the period when this is perfectly safe, and when it is also thought it will produce a better active material, and then reduce the current strength within the limits of safety as regards the life of the battery during the period when the charge is nearly completed. In the method of charging with constant potential the means for securing these objects are somewhat overdone, the current being initially too high, while toward the end of the charge time is wasted by the current being too low. He concludes that neither the constant current, the constant potential nor constant power systems can be recommended generally; the best system will be a complex one adapted to suit the conditions. He mentions a new system, which consists of charging by a series of constant currents, each less than the preceding one. The hydrometer and its application are then discussed.—FitzGerald. Lond. "Elec. Eng.," Jan. 6 and 13.

DRY BATTERY.

The results of some tests of the Hellesen dry battery, conducted by the German Reichsanstalt, showing how much these have been improved recently, are given in abstract, including the curves, in the Lond. "Elec. Rev.," Jan. 13. The internal resistance of type one is about 0.08, of type two 0.10 ohm, these resistances increasing very slowly with use; the weights are 2.9 and 1.75 kg respectively. Curves show the falling off of the voltage for a constant current of 0.2 and 0.1 ampere for about twenty days, after which the voltage was about 0.36 and 0.32, the initial being 1.58 and 1.52, respectively. Other curves show the fall of potential when discharged through a constant resistance of 5, 10 and 20 ohms. Type one discharged through 10 ohms gave a total of 145.3 ampere hours, and through 20 ohms 88.4 a. h.; the external work done during the former was 129.6 watt hours. This amount of work, if expended in raising this cell, weighing 6.38 pounds, would lift it to a height of 16,394 metres, or about 10 miles, which gives some idea of the large amount of energy per pound in such a battery.—Lond. "Elec. Rev.," Jan. 13.

APPLIED ELECTRO-CHEMISTRY.

In a short article by Mr. Edser in the Lond. "Elec. Eng.," Jan. 6, he discusses briefly the progress made during the past year, more especially with reference to the improvements in the various processes. In connection with the current density he deduces a law that the most economical current density is proportional to the square root of the following expression: "Interest on cost of cell, etc., divided by the product of the resistance of the cell per unit cathode area, and the cost of the electrical energy." The large drop in voltage at the high-current density is therefore admissible where energy is cheap; the most economical current density will not vary in direct proportion to the energy, but as the square root of that quantity, and therefore the large variations met with can hardly admit of defence.—Edser. Lond. "Elec. Eng.," Jan. 6.

CONTINUOUS CURRENTS IN THE ALTERNATING ARC.

A long translation in abstract into French, with a number of illustrations, of the article noticed in the "Digest" Nov. 5.—Eichberg and Kallir. "L'Eclairage Elec.," Dec. 31.

RECTIFICATION OF CURRENTS.

A brief, illustrated abstract of the article noticed in the "Digest" Jan. 14.—Kallir. Lond. "Elec.," Jan. 13.

REFERENCES.

Electrothermal Relations.—The author works out a mathematical theory of the relations between thermal and electric phenomena, based on the conceptions underlying Weber's theory. The original is very long. The brief English abstract closes with the sentence, "The whole paper is either a magnificent extension of our boundaries of knowledge or a terrible waste of time."—Riecke. "Wied. Ann.," Nos. 11 and 12; noticed briefly in the Lond. "Elec.," Jan. 13.

Electrolytic Decomposition of Aqueous Solutions.—The beginning of a translation of Glaser's article, noticed in the "Digest" March 5, April 2 and 23, Aug. 6, 1898. It refers to an extended series of experiments to obtain more precise information concerning the e. m. f. required for the electrolysis of aqueous solutions.—Lond. "Elec. Rev.," Jan. 6.

Electrodeposition of Tin.—The beginning of an article in which he gives the results of his researches, with which he has been occupied quite a long time.—Andreoli. "L'Elec.," Jan. 7 and 14.

Electrochemistry in 1898.—A long, classified list of articles published on this subject during the past year.—"Elektrochem. Zeit.," Jan.

Neutralization, Dissolution and Electrolysis.—An article of a theoretical nature.—Plantner. "Elektrochem. Zeit.," Jan.

Units, Measurements and Instruments.

RESONANCE METHOD OF MEASURING ENERGY DISSIPATED IN CONDENSERS.

A long description of a new method is described by Messrs. Rosa and Smith in the "Phys. Rev.," Jan., and the "Phil. Mag.," Jan. The enormous discrepancy between previously published results of the loss of energy in dielectrics, and the lack of precise statements, led them to undertake to measure this energy loss in such a way that it should be expressed absolutely. They measured by means of a wattmeter the energy dissipated when the condenser is subjected to a high alternating e. m. f. A self-induction coil for producing resonance effects is placed in series with the condenser and with one of the coils of the wattmeter. This circuit is shunted with a non-inductive resistance in series with the other coil of the wattmeter. The low-voltage current from lighting mains was used, the whole current for both of the circuits being measured in the dynamometer. The chief advantage of the method lies in the fact that voltages below 100 are used in the measuring instrument, whereas on the condenser the e. m. f. may be several thousand volts, due to the resonance effect of the coil in series with the condenser. While there are advantages in this method, there is one serious difficulty, due to the resistance of the resonance coil; if the wire for this is of large cross-section and stranded so that its resistance is small and eddy currents negligible, then no difficulty appears, and the method is then accurate as well as quick and convenient. An example is worked out and measurements thus made on beeswax and resin condensers are given.—Rosa and Smith. "Phys. Rev." and "Phil. Mag.," Jan.

MEASURING THE RESISTANCE OF CABLES CONTAINING EARTH CURRENTS.

A description of what appears to be a simple method of measuring the resistance of a cable by reversals when earth currents are strong and variable is given by Mr. Black, of the Eastern Extension Telegraph Company, in the Lond. "Elec.," Jan. 13. Briefly described, the three arms of a Wheatstone bridge are fixed resistances, and there is an adjustable resistance in series with the cable forming the fourth arm, the end of this cable being the earth connection, the pole of the battery of the bridge forming the second earth connection. This resistance is adjusted until balance is obtained and the current to the line is then reversed, balance being again obtained by altering this resistance. The resistance of the whole of the fourth arm is then calculated as usual, and the resistance of the cable is determined by subtracting from the total resistance of that

arm the arithmetic mean of the two values of the resistance in series with the cable. He shows how the formula is deduced and gives some examples of its application.—Black. Lond. "Elec.," Jan. 13.

REFERENCES.

Test of Meters for Central Stations.—The first part of a series of articles in which the author intends to deal somewhat exhaustively with the process and methods of testing meters at central stations. He describes the equipment of the rooms, the different types of meters and the methods of testing.—Prusmann. Lond. "Elec. Eng.," Jan. 13.

Hysteresis Meter.—A reprint of a description by the inventor of the meter described in the "Digest" Jan. 21.—Blondel. "L'Elec.," Jan. 7. A full description by Armagnat is given in the "Bul. Soc. Int. des Elec.," Dec.

Determining the Drop in Transformers.—Several methods are briefly described for determining the initial drop in volts between full load and no load in a transformer.—Lond. "Elec. Eng.," Jan. 6.

New Phase Indicator.—A translation in abstract, without the illustration, of the description noticed in the "Digest" Dec. 17, of the Bruger instrument.—Lond. "Elec. Rev.," Jan. 13.

Magnetic Fluxes in Meters and Other Instruments.—A reprint in full of the Physical Society paper noticed in the "Digest" Nov. 26. —Campbell. "Phil. Mag.," Jan.

Telegraphy, Telephony and Signals.

SOUND SIGNALING AT SEA.

An interesting method of signaling in channels and similar places, but which is only incidentally electrical, being chiefly acoustic, is described in a memoir in French by Mr. Lacoine, published in Constantinople, the author being the consulting electrician for the Turkish Government. It is published in pamphlet form, and a long English translation is begun in the Lond. "Engineering," Jan. 6. The method enables one to ascertain very approximately the position of a coast line or neighboring vessel. In the first case signal stations are established on each side of the channel, and are connected by a submarine cable, which enables the two different notes from two different sirens at these stations to be emitted simultaneously at fixed intervals of, say, one minute. A vessel entering the channel can then determine from the time interval between the two sounds, whether or not it is in the line of the channel; in the middle the two notes would be heard simultaneously. For the case of two lightships, connection by cable would be impossible, and the sound from one vessel is then returned by a sound from the other, the moment it reaches the latter; in this case two identical sounds are used. Charts are plotted from which the position of a vessel can be determined by measuring the intervals between these sounds. Obstacles may be plotted on such charts. The distance of a ship from a fixed point can similarly be determined in several ways, which he describes. The instrument used in this system of signaling he calls a phonophore; it can also be used for communicating by Morse signals. One way of determining distances with this apparatus is to measure the time interval between receiving a signal through the air and through water, as the velocity in the two cases is different. —Lacoine. Lond. "Engineering," Jan. 6.

RAILWAY PASSENGER COMMUNICATION.

Extracts from the reports of a committee appointed by the British Board of Trade are published in the Lond. "Elec. Eng.," Jan. 13. The conclusions drawn are that of the present methods the outside cord system should be condemned, while the inside cord is not satisfactory; the principal electrical systems and the communication by means of the brake are held to be efficient. No one of the electric systems so far excels the others as to enable the commitee to recommend it for general adoption, although they give preference to the one used on the Great Eastern Railway.—Lond. "Elec. Rev.," Jan. 13.

TELEGRAPHY WITHOUT WIRES.

In a short article the author compares the Hertzian wave system with that in which ultra violet light is used, claiming that the latter will not replace the former, and then suggests that the obscure heat rays might be used for another system, which he outlines, as they have the property of easily traversing an atmosphere charged with water, vapor and dust without being appreciably absorbed, thus making such waves adaptable for such a system. — Nodon. "L'Elec.," Jan. 7.

PRACTICAL APPLICATION OF WIRELESS TELEGRAPHY.

A note stating that the South Foreland lighthouse, in the southern part of England, is to be put into communication permanently with a neighboring lightship by means of the Marconi system.— "Elek. Zeit.," Jan. 12.

REFERENCES.

Syphon Recorder Signals.—The beginning of an article describing researches in which the author used a long artificial cable to make a series of experiments, showing the characteristic features of recorder signals under various conditions as to the capacity of the signaling condensers at the sending and receiving ends, the speed of transmission and the battery power; also to ascertain the effect on signals, of different shunts to the recorder coil, of high-resistance shunts on the signaling condensers, of condensers having low-insulation resistance, and also of one or more leaks on the cable. Many of the signals received are reproduced.—Rymer-Jones. Lond. "Elec. Rev.," Jan. 13.

Magnetic Space Telegraphy.—The conclusion of the reprint of the very long paper which was noticed in the "Digest" last week. This portion is devoted to illustrated descriptions of some of the magnifying telephones with which he experimented. It includes many illustrations.—Lodge. Lond. "Elec.," Jan. 13.

Ætheric Telegraphy.—A reprint of a short Institution paper in which the author gives a record of his long and continuous researches on signaling through space. The paper is limited to ætheric telegraphy and to its electromagnetic form.—Preece. Lond. "Elec." and "Elec. Eng.," Jan. 6.

Party Line System.—An illustrated description of a new system in which several subscribers use the same line to the central station. A table shows the rapid increase in income due to the resulting better utilization of the capital invested.—West. "Zeit. fuer Elek.," Jan. 1.

Electric Intercommunication in Trains.—The conclusion of the reprint of his very long paper, noticed in the "Digest" Jan. 7.— Langdon. "Elec. Rev.," Jan. 13.

K. R. Law in America.—A reprint of a discussion of the article noticed in the "Digest" Nov. 12, followed by a reply by Dobbs.— N. Y. "Elec. Eng.," Jan. 19.

Miscellaneous.

REFERENCES.

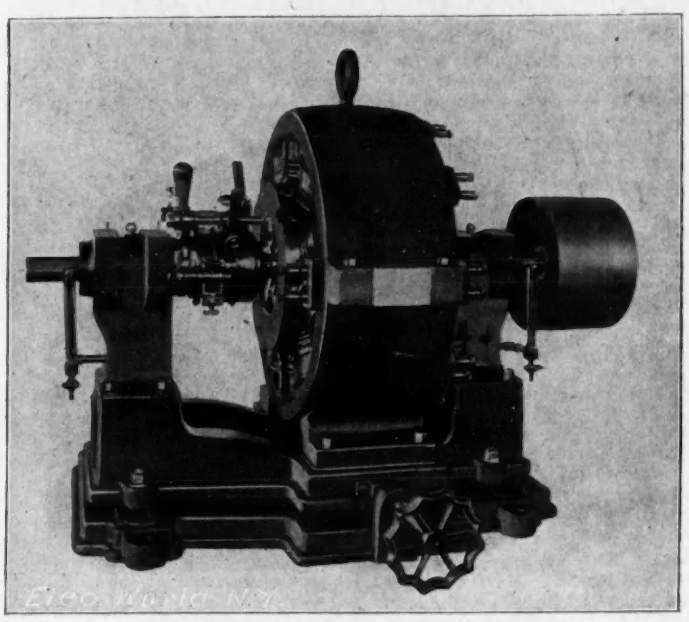
Historical.—Some interesting historical notes are given in an article by Mr. Fahie in the Lond. "Elec. Eng.," Jan. 6 and 13, on James Bowman Lyndsay, an electrician who lived during the first half of the present century. The notes refer to his life and work.— Fahie. Lond. "Elec. Eng.," Jan. 6 and 13.

"Ideal" Alternator for Experimental Work.

The accompanying illustration shows the "Ideal" alternator, which is manufactured in all sizes up to 150 kilowatts by Messrs. F. A. LaRoche & Co., Thirteenth and Hudson Streets, New York. This firm makes a specialty of building experimental alternators for colleges and scientific laboratories.

These experimental machines are generally of small size, and the following description of the 5-kw three-phase alternator furnished to the Alabama Polytechnic Institute brings out the main features of this type of machine.

This alternator is designed to generate three-phase currents at 220 volts, and is therefore supplied with three collector rings, between any two of which it is possible to obtain a current of 13.3 amperes at 220 volts when the armature is revolved at a speed of 720 revolutions per minute. Two additional pulleys are provided, by means of which it is possible to drive the alternator at 600 revolutions per minute and 420 revolutions per minute, at which speeds 180 volts



THE "IDEAL" ALTERNATOR.

and 100 volts pressure are obtained, respectively, the field excitation being maintained constant at 110 volts.

The field frame is a massive steel casting with ten poles. The ten-field spools are connected in series, each consisting of 410 turns of No. 14 B. & S. wire, requiring a field current of 3 amperes at 100 volts to excite the field at full load. The armature is 10⅞ inches in diameter, is of the tooth type, and provided with 60 slots, each 11-32 inch wide and ⅞ inch deep. The core is built up of discs of the best grade of soft sheet iron, and the winding, which is embedded in the slots, is well insulated from the core. The portion of the winding at the ends of the armature is thoroughly protected from injury by two ornamental brass-end shields, provided with openings of sufficient size to allow free circulation of air and excellent ventilation. The sixty slots provide space for thirty coils, each of which consist of twenty-one turns of No. 12 B. & S. wire. These thirty coils on the armature are divided into three groups of ten coils each, and the three groups joined together in star fashion. The coils are connected around the armature in regular order to the first, second, and third groups. The two halves of a coil are separated by

two slots. When all the coils are connected to the three groups the three starting ends are soldered together and well insulated. The three finishing ends are brought to the three collector rings.

The bearings are of the self-oiling type, and the armature so well balanced that there is no vibration even when the machine is driven at the speed of 2500 revolutions per minute. For varying the degree of tension on the belt a hand wheel and belt tightener are provided on a special sub-base furnished with the machine.

This company also builds larger alternators for single, two or three phase currents, and winds the armature for any voltage up to 2000 volts. The fields can be furnished either separately excited or provided with a composite wire. The latter is excited by a portion of the total armature current, which is rectified by passing through a special commutator. By this means the field excitation is increased as the load increases, and by making the proper adjustments any degree of compounding can be obtained.

The following is a partial list of institutions and testing laboratories of manufacturing firms supplied with alternators of La Roche manufacture: Stevens Institute, Georgia School of Technology, University of Wisconsin, Pennsylvania State College, Drexel Institute, Yale University, Alabama Polytechnic Institute, Queen & Co., Bristol Company, Hunter Fan & Motor Company, Ward Leonard Electric Company, Ironclad Resistance Company, Diamond Electric Company, Lakon Company, Keystone Electrical Instrument Company, Empire Electrical Instrument Company, Fleming-Spence Electric Company, and Dupont Laboratory.

Messrs. F. A. La Roche & Co. are prepared to build special machines according to engineers' specifications.

A Suspended Electric Fan.

One of the prime advantages of an electric fan is its adjustability. Not only may it be located where most convenient for the adjustment of piping, but it may readily be constructed in such form as to be supported or suspended as may best suit the conditions. The accompanying illustration serves to make clear this point, for it represents an entirely new design built upon a special order by the B. F. Sturtevant Company, of Boston, Mass.

The fan was designed for use on shipboard, and is suspended from the deck, In general form the fan itself is of the usual steel plate construction, being an exhauster with its inlet upon the side farthest from the motor. The motor itself is of entirely special construction, having eight poles, rendering it very

Electric Fan for Use on Shipboard.

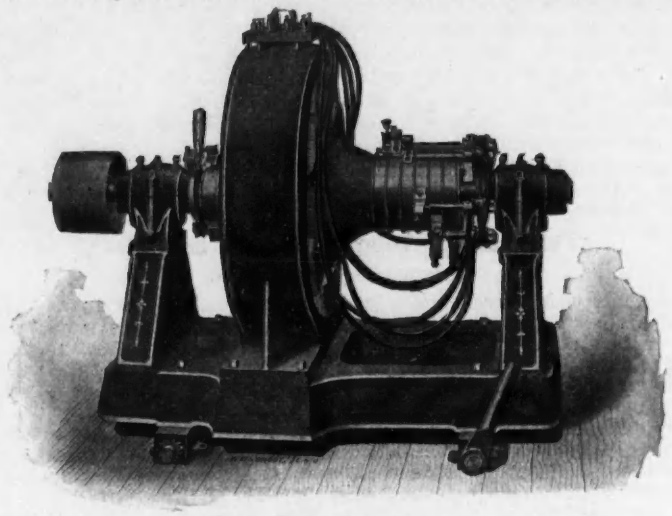
compact so that it extends the minimum distance from the side of the fan. In the size illustrated the field ring is of wrought iron, although in larger sizes it is built of cast steel or cast iron. The cast iron plate with projecting lugs which is attached to the fan-side serves to centre and hold in position the field ring of the motor, while tripod hangers extending from either side of this ring support the armature shaft in ring oiler boxes. The field cores are of wrought iron, giving the highest efficiency in the field, and the pole shoes are of cast iron of such peculiar shape and size as to render the machine capable of extreme variation of load without sparking at brushes, and without any shifting or adjustment whatever. The field coils are machine wound, and well insulated, their form being thoroughly open. The windings present a maximum amount of radiating surface, which results in the most perfect ventilation, and prohibits any great accumulation of heat. The armature cores are built up of laminated, slotted discs mounted on a cast-iron spider, having a hub projection for the reception of the commutator. These core discs are solidly clamped between two brass rings, which have corresponding core teeth. The armature is of the coil-wound drum type, and in the usual form has a two-circuit winding, although in some cases the multiple winding is used. This type of winding on machines of low speed and small output is of great advantage. The commutator is of large diameter, and consists of pure rolled or drop forged copper segments, supported in a cast-iron shell of spider construction, and thoroughly insulated. Reaction brushes of fibre graphite are used, and supported by special rigging. These motors, it is stated, require no shifting of brushes from no load to full load, thereby greatly reducing the attention required.

Evidently fans of this type can be constructed in various sizes and forms. Motors can be provided having capacities ranging from 3 to 125 horse-power.

A Generator of Interrupted Current.

The Triumph Electric Company, Cincinnati, Ohio, has brought out a new type of generator for the supply of incandescent lamps, a view of which is shown in the accompanying illustration. The machine generates a rectified or pulsatory alternating current in three independent circuits connected with six collector rings, as the wiring diagram shows. It is also fitted with a direct-current winding and a commutator for field excitation. The claims made for the machine are quite remarkable, and are given in the words of the makers as follows:

This dynamo will develop current for 50 per cent. more lights than the most modern and efficient machines, or, vice versa, will develop current for the same number of lights with the expenditure of only 65 per cent. of the energy required with any other machine. This invention is analogous to that of Corliss



New Type Generator.

in the steam engine field, the result being obtained by using the current expansively, so to speak.

The generator is multipolar, the armature windings being divided into distinct and separate circuits connected through a special commutator to separate distributing circuits with a common return, as shown in the accompanying diagram. The initial voltage generated in each circuit is 220 volts, this current being generated in each circuit for only one-third of the time, or, in other words, each coil on the armature is active for only one-third of a revolution, being entirely cut out of circuit for the remaining two-thirds. Actual test has demonstrated that when a rate of 5400 impulses per minute has been reached the light is absolutely steady.

A recent test of a 300-light machine of this type was made, as follows: Two new 16-cp, 110-volt, 55-watt lamps were selected at random from a barrel of Buckeye lamps; these were placed at each end of a Bunsen photometer; one was connected to the mains of a direct-current machine and held at 115 volts; the other was connected with the dynamo being tested, the Bunsen disc was placed in the centre of the scale and the current from the dynamo under test was brought to the same candle power as that on the direct current. All readings were taken with Weston portable voltmeters. When the candle power of the lamp on what we will call the "interrupted-current" generator was exactly the same as that on the direct current, the apparent voltage of the interrupted current was observed and the test began, the results being given below:

The dynamo was belted to a countershaft, driven by a 12 by 14 automatic engine.

Average of three cards, 33.35 horse-power. No. 16-cp lamps, 304.
Average of three cards, 24.43 horse-power. No. 16-cp lamps, 152.
Average of three cards, 13.82. Fields open.
No. 16-cp lamps per horse-power delivered at full load, 15.56.
No. 16-cp lamps per horse-power delivered at half load, 14.32.

It will be observed that these results are fully 50 per cent. better than can be

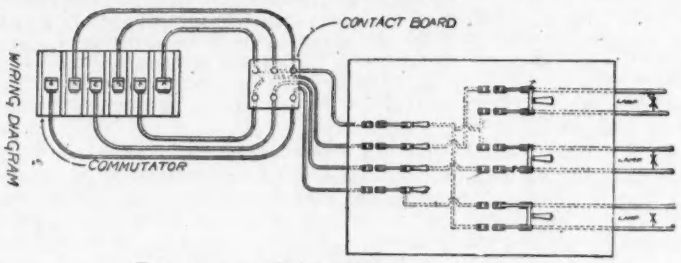


Diagram of Distribution of Circuits.

expected from any standard machine of the same capacity, also that there is a surprisingly small drop in efficiency at half load.

As will be noticed from the illustration, the machine is simple and compact. The results obtained, while remarkable, can be demonstrated to be correct theoretically, and the record of the machine itself furnishes corroboration of the theory.

This opens a new era in incandescent lighting; on the present close margin of profits no consumer can afford to overlook this opportunity of cutting down his fuel account.

The manufacturers state that they are ready to furnish a limited number of sizes at present, and to put them in on trial, permitting the machine to talk for itself.

NEWS OF THE WEEK

Financial Intelligence.

THE ERIE TELEGRAPH & TELEPHONE COMPANY'S directors have declared regular quarterly dividend No. 61 of 1 per cent., payable on February 20, to stock of record February 11.

THE NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY has declared a regular quarterly dividend of $1.50 per share, payable on February 15, to stockholders of record on February 1.

THE AMERICAN DISTRICT TELEGRAPH COMPANY, of New York, during the year 1898 earned, gross, $568,156, an increase over the previous year of $37,814; operating expenses $481,507, increase $23,078; net earnings $86,649, increase $14,736.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of New York, reports gross earnings for December, 1898, $326,450.87, an increase of $40,709.05 over December, 1897; net earnings $147,075.53, an increase of $2,664.08. The gross earnings for the year 1898 were $3,034,047.20, an increase of $542,674.82 over 1897; net earnings, $1,277,129.05 an increase of $159,632.01.

ACTIVITY IN ELECTRICAL STOCKS.—One day last week the sales of stocks on the New York Stock Exchange reached the highest point on record. Electrical stocks participated in the general advance. Metropolitan Street Railway gained 12 points and General Electric and Brooklyn Rapid Transit were among the other specially bullish features. The same condition of things prevailed in the Philadelphia stock market. On January 27 the highest record of sales on that market was made, the total number being 132,000 shares. The activity ran largely in the stock of the local street car consolidation and the new shares of the manufacturing concern which controls the electric light interests of the city. It is stated that the railway interests propose to obtain authority from the Legislature to furnish heat, light and power and become a rival of the manufacturing concern.

Special Correspondence.

NEW YORK NOTES.

THE BALL OF THE EMPLOYEES OF THE ELECTRIC VEHICLE COMPANY.—The first entertainment of an association of men employed in electric automobile work was a ball by the employees of the Electric Vehicle Company, of this city, on January 24. There are over 200 men employed by this concern, and the attendance was a large one after the cabs had come in for the night.

MESSRS. BAKER & CO., platinum refiners, have been compelled, by increased business demands, to secure additional office space, and have consequently moved their New York office from 121 to 120 Liberty Street. The new quarters are in the Beard Building, which is directly across the street from the old office. At the new office are on exhibition a number of specimens of crude platinum, among which is the nugget which is believed to be the largest in any collection on the American Continent.

THE BLOCK ELECTRIC LIGHT & POWER COMPANY, which has figured so prominently in connection with the consolidation of electric lighting interests now going on in this city, was absorbed last week by the Manhattan Electric Light Company, which is controlled by the Edison Electric Illuminating Company, of New York. The latter company is about to pass into the hands of the New York Gas & Electric Light, Heat & Power Company, and the Block Company's franchise, which is a valuable one, giving it a wide scope of operation, was a very desirable property to the new interests.

ELECTRIC POWER ON THE MANHATTAN ELEVATED.—Referring to the proposed introduction of electric power on the Manhattan Elevated Railway, Mr. Russell Sage is reported to have said that the directors of the company are proceeding with the electric equipment of the road as rapidly as plans can be arranged. A committee on electricity has been appointed, composed of President George Gould, Mr. Gallaway and Mr. Sage. This committee has authorized the president to employ an electrical expert of high standing, and this gentleman is now at work on the plans; but just what system of operation will be adopted cannot yet be said.

THE ASTORIA LIGHT, HEAT & POWER COMPANY, which was recently incorporated at Albany with a capital stock of $500,000, is said to have very broad powers. Among its objects, as set forth in the incorporation papers, are the manufacture and use of electricity for producing light, heat and power and the lighting of the streets of the city of New York. Mr. John D. Crimmins has just sold to the new company about 300 acres of land in Astoria, fronting on Bowery Bay, and including Berrian Island. According to the deed conveying the property, the consideration given is $750,000. It is stated that Mr. Crimmins paid $360,000 for the property.

DISTRICT MESSENGER SERVICE IN MANHATTAN.—According to the report of the American District Telegraph Company for the year 1898 the number of calls for messengers was 4,650,400, an increase over the previous year of 2,128,465. The company has 1475 miles of wire, an increase of 27 miles over the previous year, and 85 offices, two more than it had at the close of 1897. The number of instruments in operation in the various offices is 28,878. This represents a decrease of 580 from the number shown in the report for the year 1897. At the annual meeting of the stockholders of the company the retiring directors were re-elected, and Mr. Thomas F. Clarke was elected to succeed Mr. J. W. Clendenin, deceased.

TO TAX FRANCHISES.—A bill was introduced in the Senate, at Albany, on January 25 to tax the value of the franchises and privileges of all surface railroads, telephone, telegraph and gas, or other transportation or distributing corporations, the same as real estate, such franchises and property being defined by the bill as real estate. The object of the measure is stated by Senator Ford, who introduced the bill, to be the restoration to the schedule of taxable property the immensely valuable franchises of street railroads and other similar corporations, where they were for more than forty years preceding 1891. The enactment of this bill into a law, he said, would have the effect of increasing the taxable valuation of property in the city of New York many hundreds of millions of dollars. It is not intended, however, that the so-called franchises of railroads which have purchased their own right of way to operate over their own property shall be brought within the scope of this measure.

DAMAGE TO JERSEY CITY WATER PIPES BY ELECTROLYSIS.—The Jersey City authorities some time ago employed Mr. A. A. Knudson, an electrical engineer of this city, to ascertain whether the water mains running across the meadows were being damaged by electrolysis. Mr. Knudson made a special investigation of the mains at two points in the vicinity of the Union Traction Company's lines, and found that in each case they were being damaged by the current escaping from the rails. In his report Mr. Knudson suggests that the railway company be allowed to make proposed changes in order to reduce the leakage, such as putting in more tap connections from the return wire to the rail and examining and renewing such rail bonds, as well as cross bonds, as may be necessary. Should future tests indicate a condition still dangerous to the mains, additional methods of correcting the trouble will be suggested. It is stated that action will be taken as soon as possible to remedy the trouble.

"ELECTRICITY ON SHIPBOARD" was the title of a paper read by Lieut. S. Dana Greene, of Schenectady, at the one hundred and thirty-first meeting of the American Institute of Electrical Engineers, held on the evening of January 25. The paper was discussed by Captain Millis, Lieutenant Walling, J. W. Lieb, Jr., T. C. Martin, Elihu Thomson, Townsend Wolcott, and others. At the meeting of the executive committee in the afternoon the following associate members were elected: Royal Bradford Daggett, electrical engineer Electric Storage Battery Company, Marquette Building, Chicago, Ill.; Ernest I. Dyer, engineer and manager of the engineering department of the American Trading Company, Box 28, Yokohama, Japan; George Henry Hill, chief engineer elevator department Sprague Electric Company, Bloomfield, N. J.; Ernest Rowland Hill, electrical engineer Westinghouse E. & M. Company, Pittsburg, Pa.; William A. Lynn, assistant in electrical engineering University of California, Berkeley, Cal.; J. Manley Simpson, assistant superintendent Northwestern Grass Twine Company, St. Paul, Minn.; Thos. Perrin Thompson, electrical laboratorian Brooklyn Navy Yard; Alfred J. Thompson, electrical engineer and contractor, San Ignacio, 50, Havana, Cuba; Robert M. Wilson, student McGill College, Montreal, Que. The following associate members were transferred to membership: Philander Betts, electrician United States Navy Yard, Washington, D. C.; Winder Elwell Goldsborough, professor of electrical engineering, Purdue University, Lafayette, Ind.

THE RAPID TRANSIT COMMISSION'S DILEMMA.—A memorial of the New York Rapid Transit Commission was submitted to the Senate at Albany on January 24. It reviewed the futile efforts of the commission to carry out the rapid transit law, and its consequent inability to proceed further in its work unless further legislation is enacted. The financial condition of affairs of the city of New York, the memorial points out, rendered it impossible during the past year to borrow the money required to construct the municipal railway as contemplated by the act of 1894, and the Board of Rapid Transit Commissioners has been compelled to consider attentively what courses are now open to the city of New York to obtain the relief so long and urgently needed. Three courses suggest themselves: (1) to wait until the borrowing capacity of the city is so enlarged by a reduction of its present debt, or by an increase of assessed valuations of real estate, or by both, so as to enable it to borrow the necessary funds; (2) to obtain legislative authority to issue bonds for the county of New York for the construction of the proposed railway; (3) to obtain legislative authority to offer the franchise for building and operating the proposed railway to private enterprise. After discussing the three courses suggested, the board ventures to urge that if the Legislature shall determine that it is wise to permit a resort to private capital, the largest measure of authority and discretion compatible with the public interest shall be intrusted to the board in order that it may frame a franchise as will certainly attract sufficient private capital and arouse competition. And the board deems it of especial importance, if private enterprise is to be enlisted, that the board may be authorized in its discretion to enter into such a contract with the corporation that shall undertake the work as will exempt it from taxation for some limited period, and will insure it for a period of years at least against the possibility of legislative or municipal interference. It is stated that a bill will be presented at an early day enlarging the powers of the Board of Rapid Transit Railroad Commissioners in the manner last suggested.

COMMON-BATTERY SWITCHBOARDS IN NEW YORK.—One of the daily papers of this city has taken occasion to criticise the operation of the common-battery boards which have been installed in two of the New York Telephone Company's exchanges in Manhattan borough. Naturally the absence of a crank on which the subscriber can vent his impatience has caused some criticism, and the change from the old to the new system could not be effected without cases of trouble in the exchange itself or difficulty in teaching the subscribers the operation of the new. A writer acquainted with the subject answers the newspaper's criticisms in a way which shows up very nicely the action of the supervisory signals, part of his answer being quoted as follows:

Under the old system the subscriber's number-shutter drops, and the operator "plugs into" his number in the upright part of the board to answer his call. Under the new system the subscriber's act of taking the receiver from the hook lights a small electric lamp directly at his number in the vertical part of the board. The operator "plugs in," learns his want, and makes the desired connection if it can be obtained. The plugging in extinguishes the light. Down in the horizontal part of the board each connection is represented by two of the small lamps, which, however, are dark when the connection is made. When either of the subscribers hangs up his receiver, one of these lamps glows. When they both glow the operator knows that both people are through talking and she disconnects the lines. If only one of the lamps is alight she presumes that the subscriber whose number it represents has gone on some short errand, or turned to look up something, or left the 'phone for any reason sufficient to himself, while the other is holding the wire for his return. Consequently she doesn't interfere with it. The old annoying interruption of conversation by the operator's question to know whether one is "through" is done away with. The dread of the man who is holding the wire, when a similar question comes to him, lest a too active "Central girl" cut him off, and his haste to assure her that he isn't through, under the new system cease to be. Patrons gain peace of mind and a more satisfactory service, and the telephone company's employees gain time and are relieved of much useless trouble. Above the vertical switchboards of the operators under the new system are large electric lamps, called pilot lamps, which are set aglow whenever one of the small lamps below, either in the vertical board when a subscriber calls or in the horizontal board when a receiver is hung up after connection, is lit. These pilot lamps can be seen from the manager's desk, and so he is able to see without leaving his work there whether things are being attended to properly by the operators. If a pilot lamp remains lit for an unusual length of time he knows that something is wrong, either that a girl has not answered some call or that she has not taken down some connection. About 27,000 sets of wires are operated by the telephone company here. About 2000 instruments are now equipped under the new system in the Harlem and Riverside exchanges. When the entire service is brought under the improved system it will undoubtedly become more satisfactory. Naturally, in a system where so much is done automatically, there is likely to be at first some little difficulty with the intricate mechanism necessarily employed. But in the cities where the new system has been installed it has been found to give greater satisfaction all around than the old one.

New England Notes.

THE DIRIGO TELEPHONE COMPANY has petitioned for a location for poles in the streets of Deering, Me.

THE PORTLAND & YARMOUTH ELECTRIC RAILWAY has been sold to local parties. Seth L. Larrabee is president and Henry P. Cox is treasurer.

INCORPORATION OF A RAILWAY COMPANY.—A bill will be presented to the Maine Legislature asking for the incorporation of the Cumberland & Oxford Electric Railway.

THE CUMBERLAND ILLUMINATING COMPANY has asked the Deering, Me., city government for permission to bring current into the city at a pressure of 10,000 volts. Considerable opposition is being manifested by other electric light and telephone companies.

MR. CARYL D. HASKINS, of the General Electric Company, will sail on February 8 from New York for Europe, on the steamer "St. Louis," in the interest of that company's meter and instrument business. Mr. Haskins will make a stay of about eight weeks, visiting the larger central stations and investigating the meter systems in use in the principal cities.

MR. F. A. SWAN, electrical contractor, Boston, has secured the contract for the wiring work of the Charlestown Navy Yard. Eighteen of the large buildings are to be wired for incandescent lighting, and iron conduits will be used. Thirty-three arc lamps will be used in lighting the grounds. The buildings are situated at an average distance of about 1200 feet from the power house, and most of the feeders are of 1,000,000 circular mils section. Mr. Swan has most of the conduit work well advanced. The whole installation is to be of the very best.

THE BURNHAM ELECTRIC COMPANY, Boston, is doing a considerable amount of decorative miniature incandescent lamp work, especially in conjunction with storage-battery installations. One of its recent decorative designs was used at the Shuman-Brandt wedding. The couple stood under a floral canopy, and in the background the letters "S" and "B," representing the names of the contracting parties, were formed by clear, miniature lamps. At the proper point in the ceremony the lamps were extinguished, and the two letters were substituted by the single letter "B" in red. The arrangement was unique and very prettily gotten up. The Burnham company is installing storage-battery lighting plants at Woodstock, Vt., and Troy, N. H., and has estimated on several others.

ELECTRIC TRANSMISSION OF POWER FOR WOOLEN MILLS.—At the thirty-fourth annual meeting of the National Association of Woolen Manufacturers, held recently at Young's Hotel, Boston, Mr. C. J. H. Woodbury read a paper on the "Electric Transmission of Power for Woolen Mills." He said that the question of the transmission of power in a mill was the governing factor in the whole of the mill design, and that electric transmission of power is the latest step in mill development. He emphasized the fact that as it requires only provision for running the wires to the motors on each story, the mill engineer is perfectly free to devote himself entirely to the design of the mill as a manufacturing organization without reference to any of the impediments ordinarily involved in the conveying of power through a building. Furthermore, power in an existing mill may be augmented by the electric transmission of water power from a distance, but it is essential that every steam or power transmission should be studied by itself. He illustrated the principles of the electric motor by simple and original experiments, and called attention to the fact that over 200,000 horse-power is now produced by electric motors in the United States.

Philadelphia Note.

"PRACTICAL APPLICATION OF THE ELECTRIC MOTOR TO PRINTING-PRESS MACHINERY" was the title of a paper read before the electrical section of the Franklin Institute, by Mr. W. H. Tapley, on the evening of January 24. Mr. Tapley, who is connected with the United States Government Printing Office at Washington, asserted that probably no one branch of power application could show the results in power saved, improved product and increased output from the application of the electric motor as those obtained from printing machinery so driven. That nothing be sacrificed in economy of operation and completeness of outfit it is necessary that care be exercised in the selection of the type of motor, method of control and attachment. Of the series, shunt and compound motors, Mr. Tapley said the latter gives the most satisfactory results. Belted, geared and direct-connected motors can be used, though geared and direct-connected are distinctly advantageous over belting from main-line shafting. The selection as to which is better must be decided in each individual case. Of the various methods of control for direct motors, the combination of armature and field control, he stated, is best. Armature control, with carefully proportioned gearing, in motors of sizes up to 5 horse-power is a dangerous rival of direct-connected motors. All individual motors should be so attached to the frame of the press as to be practically part of it; separate motor foundations are a failure. Geared motors should be supplied with rawhide pinions, having brass sleeve and sides, always using single reduction. Ratios of 10-1 are permissible where the press speed is not over 120 r. p. m.; 5 and 3 to 1 where the speed is 175 r. p. m. and upwards. Direct-connected motors should be used where noise is an objection, as well as on all large presses, especially for newspaper work. Each equipment should be provided with an automatic circuit breaker. This is an absolute necessity if it is desired to obtain all the advantages of the individual drive. The cost of direct versus geared press equipment, for new presses, is 25 to 33 1-3 per cent. more for the former. Where old belted presses are to be changed the cost is about the same, the gearing with fixtures amounting to the difference in cost between motors. This applies to 5-hp motors and larger; smaller sizes may cost very much more, sometimes twice as much. The general advantages secured by substituting individual electric drive for belting are economy of power, positive speed applied direct to the main driving shaft of the press, ability to locate the press without reference to the main line of shafting, freedom from dust and dirt, higher grade work and increased output, which should amount to 15 per cent., without extra wear on the machinery. These will pay for the electric equipment within three to five years. With flat-bed presses, printing 32 pages 16mo per impression, an average output can be secured, including all allowances for "make ready" and handling paper, of 21,000 pages per kw hour, at a cost of 5 cents; 4200 pages can be printed at a cost of 1 cent. Web presses, doing the same class, size and grade of book work, will print, cut and fold, 91,000 pages per kw hour, at the same cost, or 18,000 pages at a cost of 1 cent. A comparison shows a difference of 4½ times in favor of the web presses. When a large number of presses are in use a ratio of horse-power in motors to horse-power in generators installed of 5½ to 1 may be safely made.

Southern Notes.

THE COLUMBIA TELEPHONE COMPANY is the name of a concern seeking incorporation in the District of Columbia. For this purpose a bill has been introduced in the House.

MUNICIPAL PLANT PROPOSED.—An election will be held in Fredericksburg, Va., on Februaary 28 to vote on the question as to whether the council shall erect and the city own an electric light plant for the illumination of the streets.

ELECTRIC LIGHT is to be introduced in the Soldiers' Home at Richmond, and both the grounds and building will be illuminated by incandescent and arc lights. The generating plant will be modern and complete in all respects, the contractors for the plant being Messrs. Tower, Blankenship & Binford.

TO PUT ELECTRIC WIRES UNDERGROUND IN RICHMOND.—A movement is on foot in Richmond, Va., to place in conduits all electric wires now running overhead in the streets of the city. A company is applying for a charter to construct conduits. It is composed of some of the best citizens of Richmond.

TELEPHONE LINE TO A CALIFORNIA LIGHTHOUSE.—A bill has been introduced in the House authorizing the Secretary of the Treasury to construct a telephone line from the United States lighthouse at Point Trinidad, Cal., to connect with the general telephone system at Trinidad in Humboldt County, Cal.

THE VIRGINIA ELECTRIC RAILWAY & DEVELOPMENT COMPANY has filed a mortgage to the Richmond Trust & Safe Deposit Company to secure an issue of $1,500,000 first mortgage bonds. The Virginia Company some time ago purchased the Haxall-Crenshaw mills at Richmond, and is now at work developing the enterprise, which includes the generation of electric power, the building of a large pulp plant and other projects.

THE RECONSTRUCTION OF ELECTRIC PROPERTY IN LYNCHBURG.—Contracts for the reconstruction of the property of the Lynchburg Electric Railway & Light Company have been awarded to the Virginia Paving Brick Company, of Lynchburg, at about $70,000. The active work of reconstruction is about to begin. President R. Taylor Cleaves, of the Virginia Paving Brick Company, is now in the North purchasing material.

AN ELECTRIC LIGHTING SYNDICATE.—It is stated that final arrangements have been made by which the control of the United States Electric Lighting Company in the District of Columbia will pass into the hands of a

newly formed syndicate. A total of about 6400 shares of stock out of 11,000 shares will pass over to the new interests and the price that will be paid for each share is said to be $150. It is reported that neither the Washington Gas Light Company nor the Potomac Light & Power Company will be allied with the new enterprise.

FIGHT BETWEEN THE CITY AND THE RAILROAD COMPANY.—In Newport News, Va., the fight between the city and the street railroad company is still on. The company recently applied to the Circuit Court for an injunction to restrain the city from granting to any other corporation or individual privileges conflicting with the rights of the Newport News and Old Point Comfort Railway & Electric Company; to declare the action of the city council in revoking the company's franchise to be illegal and to permit the company to resume work. Judge Blackstone granted the first petition, but the other two points were set aside for discussion later.

A TRANSFORMER STATION NEAR HYATTSVILLE.—Arrangements have been completed for the establishing of a substation near Hyattsville, Md., where transformers will be installed to reduce the high potential current delivered from the power station of the Potomac Electric Power Company in Georgetown to a lower pressure for the use of the overhead trolley road of the City & Suburban Railway operated in that section. The initial voltage at Georgetown will be about 6000 volts, at which pressure it will be transmitted to the Hyattsville station by overhead wires. Work on the substation will be commenced about March 1, and it is expected that the road will be in operation about April 1.

RAILROAD FARES IN THE DISTRICT.—Senator Carter, of Montana, has proposed an amendment to the bill authorizing and requiring certain extensions to be made to the lines of the Capital Traction Company in the District of Columbia. The amendment provides that the Capital and other street railway companies chartered and operating in Washington shall be required to charge a fare of three cents between the hours of 6 and 9 a.m. and 4 and 7 p.m. At other times they shall be permitted to charge the fare now provided by law. A penalty is imposed for failure to comply with this provision. It is also provided that the Capital Traction Company and the Metropolitan Railroad Company shall each pay to the District Commissioners one per cent. of their gross annual receipts to be applied toward the construction and maintenance of the Washington Public Library.

THE ADVANTAGE OF USING IMPROVED APPARATUS AND DEVICES.—In the last quarterly report of Chief Engineer Baird, superintendent of the State, War and Navy Departments Building, that official gives some interesting facts regarding the saving of fuel consumption by the adoption of modern apparatus and appliances. To light the building by electricity, run the elevators, printing presses, etc., 714 tons of coal were consumed, this being 6½ per cent. less than the consumption during the same months last year, notwithstanding the increased load on the dynamos and the extended hours of elevator service during and since the war. The economy has been effected by the use of a better quality of lamps, substituting electric motors for steam engines to drive the printing presses, introducing feed water heaters and by taking advantage of the weather predictions as to light and dark days. The executive mansion is lighted from the same plant and this arrangement provides a fairly steady load on the generating plant both day and night, since light is used by day in one building and by night in the other. In the State, War and Navy Building there are 2591 lamps, 341 electric fans and 14 large power motors; in the executive mansion there are 1000 lamps, 14 fans and 2 large motors. The maximum load that can be placed upon the dynamos exceeds their output by 50 per cent.

BUFFALO AND NIAGARA FALLS NOTES.

PERSONAL.—Mr. W. K. Dunlap, resident engineer and representative at Niagara Falls of the Westinghouse Electric & Manufacturing Company, sailed for Europe this week for a somewhat extended tour for his health.

MR. I. F. EDMUNDS, resident engineer of the General Electric Company at Niagara Falls, has accepted a position as electrical engineer of the Union Carbide Company. He will assume his new duties on February 1.

THE LIMA-HONEOYE FALLS ELECTRIC LIGHT & RAILWAY COMPANY.—On motion of a majority of the directors, the courts have appointed Charles B. Hill, of Buffalo, receiver for the above corporation.

BUFFALO, HAMBURG & AURORA RAILWAY COMPANY.—Arrangements have been made by which the cars of this road will be allowed to enter the city of Buffalo on the tracks of the Buffalo Railway Company. General Manager Upson states that a large amount of material is on the ground, and that contracts will be let on February 1 for the construction of the line from Buffalo to Hamburg. An equipment of twelve motor cars and six trailers is proposed. It is expected to begin work as soon as the spring weather will allow.

ELECTRIC RAILWAYS IN NATAL.—Mr. John Roberts, electrical engineer of the Borough of Durban, Natal, South Africa, is in the United States studying American methods of electric railway construction, and visited Buffalo to examine the Buffalo Traction Company and the Buffalo Railway Company. The corporation of Durban proposes to construct about 17 miles of railway, using 9-inch grooved rails with concrete road-bed, steel poles with span wire and bracket overhead construction. On his return to Natal Mr. Roberts will prepare plans and specifications upon which the borough will construct track and set poles and contract for overhead equipment, rolling stock and power plant. American apparatus seems to be favored. Purchases will be made through Messrs. Webster, Steele & Co., East India Avenue, London, E. C.

PAN-AMERICAN EXPOSITION.—On Saturday, January 21, a banquet was held by the incorporators of the Pan-American Exposition Company. There was much enthusiasm, which took the substantial form of subscriptions for capital stock amounting to $427,000. On the following Monday public subscription lists were opened, and at the date of writing (January 27) the total subscriptions at 3 P. M. had reached $915,760, with enough more in sight to pass well beyond the million mark before Saturday evening. At a meeting of the incorporators held on January 27 it was decided to secure authority to increase the capital stock to $2,500,000 and issue no bonds. As soon as possible a meeting will be held to elect twenty-five of the incorporators, who will form the nucleus of the corps of administration. Representative D. S. Alexander has introduced into Congress a bill appropriating $500,000 for a United States Government exhibit, which, it is believed, has the support of the administration.

CHICAGO NOTES.

A TELEPHONE FRANCHISE GRANTED.—The City Council, on the night of January 23, granted a fifty-year franchise to the Illinois Telephone & Telegraph Company to conduct a general telephone and telegraph business in this city. Further information concerning the new enterprise was given in the Chicago notes in THE ELECTRICAL WORLD of January 21.

THE CENTRAL UNION TELEPHONE COMPANY.—The annual report of the Central Union Telephone Company for the year 1898 shows gross earnings of $1,667,167, against $1,439,001 in 1897; expenses, $1,307,829, against $1,151,201, leaving a net revenue of $306,337, against $287,799. On December 31, 1898, the number of exchanges of this company was 175, an increase of twenty-two over the previous year. The number of subscribers at the close of last year was 45,186, against 36,331 at the end of 1897; number of toll stations, 1573, against 1166. The report states that the property conditions of the company are rapidly being transformed into a superior class, and while the stockholders have patiently waived dividends for a time, it is confidently believed that their sacrifices in this respect are but temporary; while, on the other hand, the value of the property, both intrinsically and in earning power, is surely and certainly advancing.

THE CHICAGO TELEPHONE COMPANY.—At the annual meeting of the Chicago Telephone Company, held on January 18, the report submitted showed an increase in gross earnings for the year 1898 over 1897 of $235,880, or 11 per cent.; the increase in net earnings was only $9259, or about 1½ per cent. The capital stock outstanding on January 1, 1899, was $4,336,500, and the earnings on capital stock were 14.6 per cent. In this report President Clark states, among other things, that the growth of the telephone business within the territory controlled by the company seems to have been due in part to the general improvement in business conditions requiring increased telephone service; in part to the increased effort made by the contract department in the way of soliciting advertising and other methods of reaching the public, and in part to several reductions in the rates that have been made by the company during the year. These reductions consist chiefly in a more general use of the party-line service by subscribers, both in the city and in the suburban exchanges; in lowering the price charged for certain toll service, for desk instruments, branch exchange service, etc. The average price received by the company for each telephone in service for the year 1898 was nearly $13 less than that received during the previous year, while the cost to the company of maintaining the service has not been proportionately reduced. Many automatic telephones are scattered throughout the city in drug stores, the revenues from which average considerably below the rate established by ordinance. During the year 1898 the tax of 3 per cent. under the provision of the Chicago city ordinance, amounted to $46,908. The amount paid to the general government under the provision of the war tax has exceeded $500 a month, and will reach a total of about $7000 a year, exclusive of the stamp tax. The wire plant of the Chicago Telephone Company in the city of Chicago on December 31, 1898, was as follows: Underground cables (including submarine), 29,720.29 miles; aerial cables, 10,172.14 miles; pole lines and on housetops, 9,189.66 miles; total, 49,082.09 miles. The company has within the limits of the city twelve general exchanges, employing 576 operators, and its monthly pay-roll is about $75,000 or $900,000 per annum. The following-named gentlement were elected directors: J. Russell Jones, John M. Clark, Norman Williams, Robert T. Lincoln; Arthur D. Wheeler, Byron L. Smith, Albert A. Sprague, C. E. Perkins, William A. Jackson, John E. Hudson and Joseph B. Davis.

ST. LOUIS NOTES.

THE SUBURBAN ROAD INCREASES ITS STOCK.—The stockholders of the Suburban Railway Company have voted to increase the capital stock of the company from $2,500,000 to $3,000,000. They also voted to increase the bonded indebtedness of the company $500,000. The additional money, it is said, is to be used in improvements and extensions.

CITY WIRE CONNECTIONS.—The National Conduit & Cable Company has finished its contract of putting in the lateral electric connections between the conduits of the Bell Telephone Company and the city buildings. This includes the connection of the fire and police alarm telegraph. The work of putting the city wires in the conduits is in progress. In a couple of days bids will be opened on the contract for making the lateral connections between the city buildings and the Kinloch Telephone Company's conduits.

PACIFIC COAST NOTES.

THE YOSEMITE VALLEY Commissioners have decided to ask the California Legislature to appropriate $13,000 for the establishment of an electric-lighting system for the valley. An appropriation for a waterworks system will also be petitioned for.

WATER POWER FOR ELECTRIC LIGHTING AT ELIGIN.—An electric lighting plant and waterworks system will be established in Elgin, Oregon. H. V. Gates, of Hillsboro, Oregon, recently entered into a contract to do the work required. Water power will be utilized, making use of a flume two miles in length.

PROPOSED ELECTRIC TRANSMISSION TO EVERETT, WASH.—Surveys were made recently near Granite Falls, Wash., for a water-power electric transmission system which is likely to be installed by the Monte Cristo Railroad Company. A dam across the south fork of the Stillaguamish river was one of the principal points in the work. It is proposed to operate the street railway, the manufacturing plants and the city lights in Everett,

Wash., from the projected plant. It has been estimated that the cost of the electric system would be repaid by the saving in fuel in three years.

A STOCK DIVIDEND.—The Central Light & Power Company, San Francisco, has declared a dividend. The notice stated that an order was adopted distributing by way of dividend to the stockholders of that corporation the shares of stock of the Equitable Gas Light Company belonging to the Central Light & Power Company, subject to the pooling agreement now in force. Pursuant to the order such stock will be placed in escrow, subject to the pooling agreement in lieu of the certificate issued by the Equitable Gas Light Company to the Central Light & Power Company. The last-named company does electric lighting.

FOR THE PROTECTION AND PRESERVATION OF WATERSHEDS.—The Miners' Association of California called a convention, which recently met in San Francisco, to discuss measures for the conservation of water and the protection of watersheds. Means for the preservation of forests, to retain melting snows in the mountains, and the erection of impounding dams, were among the subjects considered. If the water which is wasted annually in California could be stored by judicious engineering, there would be an ample supply for all purposes. The electrical interests will be greatly affected by the action taken.

Canadian Notes.

THE HULL & AYLMER ELECTRIC RAILWAY COMPANY has purchased from the Canadian Pacific Railway the line from Hull, Que., to Aylmer, Ont., over which the former company's cars now run. Since the beginning of its service the Hull-Aylmer Electric Company has been using the tracks under lease, but a deal has now been completed whereby it becomes possessor of the line for $100,000.

MUNICIPAL ELECTRIC LIGHT AND RAILWAY.—The town of Dartmouth, Nova Scotia, is asking power from the Provincial Legislature to issue $150,000 of bonds for the purpose of operating an electric street railway in that town and vicinity. A bill will also be submitted empowering the issuing of bonds to the amount of $50,000 to establish an electric light plant for lighting the streets and public buildings.

THE HAVANA STREET RAILWAY.—Mr. E. Hanson, of Hanson Brothers, bankers and brokers, Montreal, has just returned from New York, where he has been closing the deal for the Havana Street Railway. He says that they have now actual possession of the Havana Street Railway, which his company has been operating since January 1. The railway will be run for a time as it now is, drawn by mules, but in a short time electricity will be used.

French Notes.

AN ELECTRIC AUTOMOBILE.—An electric vehicle designed by the Comte de Chasseloup-Laubat, and built by M. Jeantaud, has just broken the record for 1 kilometre (0.62 mile), flying and standing starts, in a competition organized by M. Paul Meyan, and which took place at Acheres December 18, Sunday. The distance was made from a flying start in 57 seconds on a level road. This is at the rate of 65.15 kilometres, or 39.2 miles per hour, which, for the present at least, is surely the world's record.

DAMAGE TO TELEPHONE LINES BY STORM.—An extremely severe snow and ice storm, accompanied by high winds, swept over France during the 2d and 3d of January, doing an enormous amount of damage. The telephone systems most affected by the storm were those of Lille, Dunkerque, Valenciennes, Douai, Amiens, Nancy, Epinal, Lyons, Marseilles, Limoges, Pau, Tours, Nantes, etc. It was said at the executive offices of the Postal Department that communication was completely cut off between France and Austria, Spain and Portugal for a whole day. A single line only to Frederica —over a Russo-Danish cable—was in operation.

ELECTRICITY FOR THE WESTERN RAILWAYS COMPANY'S SUBURBAN SERVICE.—The French Electric Cable Company has just contracted with the Western Railways Company to lay and maintain for thirty years, for a fixed yearly charge, some 35 miles of underground cables (Berthaud & Co.'s make), which will be used to transmit power from the General Traction Company's power house at Moulineaux. This latter company has also contracted with the railway company to furnish electric power in quantities to meet the necessities of the railway company for a period of thirty years. At present only the new electric line building between the Champ de Mars and Versailles will take electric power, but in the course of time the railway company expects to electrically equip all its suburban lines. As the railway adds to its electrical equipment the power company will add to its capacity. The cables to be furnished by the French Cable Company will be used in connection with a three-phase alternating-current of 50 periods and 5000 volts.

A NEW TELEPHONE.—Professor Dussaud, of Geneva, has sent to the Academy a description of his new telephone, which he showed with much success before a large audience in the great hall of the university of that city. M. Dussaud writes that though the transmitter was situated in a distant laboratory, and though the hall itself contained over a thousand seats and was well filled, every sound emitted by the instrument could be heard distinctly in every part of the room. This new instrument is arranged as follows: A highly sensitive carbon transmitter is connected up with a receiver having four poles and four diaphragms instead of one. Moreover, the air is admitted to both sides of these diaphragms, which doubles their efficiency. Eight very short tubes concentrate the vibrations received from the diaphragms in a resonator about the size and shape of the buccal cavity. In Geneva this apparatus has been used in connection with the regular city telephones, and has worked very well with them. Persons who are hard of hearing have been able to use the telephone with the help of this arrangement, though unable to use the ordinary form. On Thursday, December 15, M. Dussaud exhibited one of his instruments in the Salle d'Armes de Figaro. An ordinary speaker could be heard at a distance of from three to six feet from the receiver without the use of any megaphone attachment. Various pieces of music were sung and played through it. There were a number of scientists and distinguished persons present by invitation of the inventor, Monseigneur Prince Roland Bonaparte, Colonel Lansedat, M. Violle, of the Academy of Sciences, and others.

MONTHLY MEETING OF THE ELECTRICAL SOCIETY.—M. Vedovelli gave descriptions of the apparatus which he had on exhibition. He spoke of having found brass to be the best for contact-making purposes. He showed a multicircuit switch, also a 1500-ampere switch, and he said that his experience showed that a slow break is preferable to a quick break. Lastly he described a 4000-ampere reducer for use with electric motors. The firm of Genteur showed a 1000-ampere switch, to be used on a 3000-volt circuit. M. Mornat detailed his experience with bronze for contact purposes, and said it gave good results. He also described a circuit breaker using oil, which has given good results. The French Electrical Equipment Company exhibited a two-pole, 400-ampere switch; a two-pole, two-way, 200-ampere switch; a 3000-volt, 30-ampere, two-pole switch; a fuse for a 3000-volt circuit, with protection box. M. Zelter described an automatic switch for opening and closing the primaries of transformers on alternating systems and used for elevator work. M. Ohlinger had with him a 3000-volt, 30-ampere switch; also a 600-volt, 50-ampere switch, and a voltmeter reading up to 3000 volts. The discussion was then led to the subject of fuses by M. Hillairet. M. Vedovelli maintained that sufficiently accurate results may be obtained with fuses on low voltages, but that with high voltages the case is quite different. He has got the best results from an alloy of lead, tin and antimony. M. Hillairet called attention to the necessity of knowing beforehand the exact conditions under which an instrument is to work if its value is to be properly understood. Sometimes effects may result which it is well to know how to turn to advantage. In the case of contact pieces it is well to study the vapors which form around contact points, and which may be either of a reducing or an oxidizing nature, according to the metal used. Brass, zinc, iron and carbon all tend to quench an arc.

General News.

New Incorporations.

THE WOODFORD TELEPHONE COMPANY has been incorporated at Raleigh, N. C., with a capital stock of $15,000.

THE KESTER ELECTRIC MANUFACTURING COMPANY, Chicago, Ill., has been formed with a capital stock of $20,000, the incorporators being W. L. Cadle, J. M. McGrew and G. Hunt.

THE ELECTRICAL IMPLEMENT COMPANY, New York, N Y., has been incorporated with a capital stock of $20,000. The incorporators are C. D. Cooke, Paterson, N. J.; T. E. Taylor and G. M. McWilliams, New York City.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, has been incorporated for the purpose of manufacturing telephone and telegraph equipment. The incorporators are C. H. North, G. C. Steele, D. B. Wick, R. A. Wilbur and M. B. Johnson. Capital stock, $500.

THE UNION TELEPHONE COMPANY, Sidney, N. Y., has been formed for the purpose of operating a telephone line in Delaware and Otsego Counties. The directors are D. R. Buckley and E. O. Allen, of Unadilla, and John Spickerman, of Sidney. Capital stock, $10,000.

THE PERTH AMBOY RAILROAD COMPANY, of New Jersey, has been incorporated, with Leonard Lewisohn as president; C. J. Whittenberg, vice-president, and H. C. McCoy, secretary. The company has a franchise to run a trolley line from Perth Amboy to New Brunswick.

THE SHERMAN ELECTRIC LIGHT COMPANY, Sherman, N. Y., has been formed, the capital stock being $5000. The directors for the first year are: Charles E. Cobb, F. D. Cornish, C. H. Corbett, T. J. Newell, T. D. Poate, W. A. Edmunds and George D. Marsh, all of Sherman.

THE PUERTO RICO COMPANY has been incorporated at Trenton, N. J., with a capital stock of $1,000,000 for the purpose of manufacturing and selling gas and electric power in the West Indies. The incorporators are Matthew Randall, Nathan J. Mitchell, Edmund C. Alsop and Frank B. McAvoy.

THE GREEN RIVER TELEPHONE & TELEGRAPH COMPANY, Owensboro, Ky., has been organized to construct a line from Owensboro to Henderson and other points. Among those interested are J. H. Hickman, president and treasurer, and H. K. Cole, vice-president and general manager.

THE EMPIRE ELECTRICAL MACHINERY COMPANY, Jersey City, N. J., has been formed for the purpose of manufacturing electrical machines, etc. Among those interested are Francis Larkin, Sing Sing, N. Y.; Warren P. Freeman, Jersey City, N. J.; Robert J. Campbell, New York. Capital stock, $300,000.

THE MIDDLESEX & MONMOUTH ELECTRIC LIGHT, HEAT & POWER COMPANY, Jersey City, N. J., has been incorporated for the purpose of furnishing electric light, heat and power. The incorporators are John Karr, Hackensack, N. J.; Stirling Birmingham and Henry H. Holmes, New York. Capital stock, $50,000.

THE FRANKLIN TELEPHONE & TELEGRAPH COMPANY has been incorporated at Albany, N. Y., with a capital stock of $12,000 for the purpose of operating a telephone system from Saranac Lake to Keene, Bloomington, Tupper Lake, Saratoga Inn and intermediate points. The directors are Frank E. Kendall, M. B. Miller, C. F. Wicker, Joseph Merkel, F. M. Jackson, Tuffield Latour and H. P. Coats, all of Saranac Lake.

THE HOME TELEPHONE COMPANY, of Rochester, N Y., has been formed with a capital stock of $150,000, for the purpose of operating a telephone system in Rochester and elsewhere in Monroe County. The directors are Frederick Cooke, Thomas W. Finucane, George W. Archer, Albrecht Vogt, H. Wheeler Davis, Gustave Erbe, George R. Fuller, Jacob Gerling, J. Foster Warner, Edward W. Peck, Horace C. Brewster, Eugene H. Satterlee, Willard B. Spader, V. Moreau Smith and Ezra M. Higgins.

The Telegraph and Telephone.

BOSTON, MASS.—The Erie Telegraph & Telephone Company has made a contract for 4,000,000 pounds of copper wire.

CHATTANOOGA, TENN.—The East Tennessee Telephone Company will at once extend its long-distance lines to Winchester, Tenn.

CLEVELAND, OHIO.—The Cleveland Telephone Company has been authorized to increase its capital from $2,000,000 to $3,000,000.

PLAINFIELD, WIS.—The Union Telephone Company will extend its line to Stevens Point, 23 miles from here, and work will be commenced at once.

FAYETTEVILLE, ARK.—The North Arkansas Telephone Company has been granted a franchise to operate and maintain a telephone system in this city for a period of twenty-five years.

PRINCETON, KY.—The Dawson Telephone Company has completed its line from Cerulean Springs to Cadiz. The circuit now extends from Dawson to Madisonville, Hopkinsville, Cadiz and Princeton.

GREENCASTLE, IND.—The Greencastle and Bell Union Telephone Company has been incorporated, with George W. Bence, Jesse Richardson, Squire J. Hurst, Daniel Moffett, and George Hathaway as directors.

ASBURY PARK, N. J.—The New York & New Jersey Telephone Company will soon commence the work of building a ten-wire line from Freehold to Asbury Park, a distance of 15 miles. The cost will be about $16,000.

LOS ANGELES, CAL.—Sealed proposals will be received by the city clerk until 11 a. m., February 20, 1899, for the supply of 50 police signal boxes, one central station outfit, storage battery and switchboards. Further information can be had on application to the city electrician.

SPRINGFIELD, OHIO.—The Tri-state Telephone & Telegraph Company has applied to the authorities for a franchise. This makes the fourth company that has made a similar application. The Tri-state company agrees to make a rate of $24 for business instruments and $18 for residences.

WARREN, OHIO.—The Warren and Niles Telephone Company expects within six months to have direct connection with Cleveland and Youngstown on a line to be built by the United States Telephone Company, of Cleveland. The Cleveland company expects to build a line to Youngstown by May 1.

OWENSBORO, KY.—The Green River Telephone & Telegraph Company has been organized in this city to build a telephone line from Owensboro to Henderson. Dr. J. H. Hickman has been elected president and treasurer, H. K. Cole vice-president and general manager, and T. A. Pedley secretary.

CHEYENNE, WYO.—The Opal & Big Piney Telephone Company has filed articles of incorporation, with a capital stock of $5000. It will construct a telephone line from Opal, on the Oregon Short Line Railway, to Big Piney, a distance of 70 miles. The incorporators are ranchmen in the vicinity of Big Piney.

LAKELAND, WIS.—The Inter-State Telegraph and Telephone Company has been organized at Lakeland. The officers are A. T. Presson, president; R. H. McCoy, vice-president; H. L. North, secretary and treasurer. The object is to connect Hudson and New Richmond with the independent system in the twin cities.

SAN FRANCISCO, CAL.—It is stated that the coast survey steamer "Ranger" has been ordered to make a survey for a submarine cable route to Manila. She will take deep-sea soundings from Honolulu to Guam, thence to Manila. The cable route from San Francisco to Honolulu has already been surveyed.

JERSEY CITY, N. J.—The State Telephone Company, which was incorporated about three years ago for the purpose of connecting all the local telephone companies in the State, has commenced building a line between Bound Brook and Trenton. A line has already been erected between Bound Brook and Newark.

JEFFERSON CITY, MO.—A bill to regulate the charges for telephones has been introduced in the House, making the rate for business houses $36 per year within a distance of three miles from the business centre and $48 a year outside of the three-mile limit. For residences the rate is $24 within the three-mile limit and $36 outside of it.

BOSTON, MASS.—A new rate schedule for conversations within the Boston suburban district has been inaugurated by the New England Telephone & Telegraph Company. It is 10 cents for three minutes' conversation, and 5 cents for every additional three minutes. The former rate at pay stations was 15 cents for five minutes' conversation.

TOPEKA, KAN.—The bill which was introduced in the Kansas Legislature providing for a reduction of telegraph rates and placing telegraph companies under the supervision of the Court of Visitation was passed and has been signed by the Governor. The provisions of this bill were outlined in THE ELECTRICAL WORLD of January 14.

ASHLAND, OHIO.—The Star Telephone Company, with a capital stock of $50,000, has been incorporated at Columbus by Messrs. George A. Ullman, E. J. Grosscup, J. R. Swartz, S. H. Grabill and George R. Freer. The Star Company succeeds the People's Telephone Company and paid $30,000 for the latter's system. The new company intends to extend the service.

CRAWFORDSVILLE, IND.—The city of Crawfordsville has brought suit for an injunction against the Central Union Telephone Company, asking that the latter be enjoined from using the streets of the city for its business. The complaint recites that the telephone company, by neglecting to maintain an exchange here for several years, had forfeited its franchise.

NORRISTOWN, PA.—The board of directors of the Keystone Telephone Company at a recent meeting decided to extend their lines to Sumneytown and Greenlane, provided sufficient encouragement is received along the proposed extension, work to begin not later than May 1. It is the object of the company to extend the line to Pennsburg and East Greenville in the near future.

CHAGRIN FALLS, OHIO.—A deal has been completed between the Falls Telephone Company and the United States Telephone Company, of Cleveland, whereby the local company's line will be connected with the lines of the other company, and by the construction of an independent line Chagrin Falls, all Geauga County's towns, and all farmers of prominence in Geauga and Cuyahoga counties will have direct communication from their farm residences with Cleveland business houses.

COLUMBUS, OHIO.—The stockholders of the Ohio Telephone Company have organized and elected a board of directors. The directors elected the following officers: David C. Beggs, president; Theodore B. Beatty, vice-president; Thos. A. Simons, secretary, and Howard C. Park, treasurer. In case the City Council should give this company a franchise, it is proposed to increase the capital stock from $100,000 to $500,000. It was also decided to commence work of putting in the plant as soon as the franchise is granted.

A PROPOSED DIRECT CABLE TO GERMANY.—Information comes from London to the effect that a joint stock company is being organized in Cologne to lay a submarine telegraph cable direct from Germany to the United States. It is reported that negotiations for the formation of a company for this purpose have been progressing quietly for several months, but with the cognizance of the German Government. The company's capital stock is stated to exceed 10,000,000 marks.

BALDWINSVILLE, N. Y.—The Baldwinsville Telephone Company has perfected arrangements whereby it is able to give its subscribers in this village connection with Syracuse. Its charge for such service will be 10 cents, while the Bell Telephone Company charges 25 cents for similar service. It is generally stated that the Bell Telephone Company would not have put in an exchange in this village had it not been for the local company; therefore many of the citizens believe that the business men should stand by the company which was the cause of this benefit.

DES MOINES, IOWA.—At the annual meeting of the Mutual Telephone Company President Hill stated that the company had now a total of $74,000 invested in plant and lines. During the past year 365 new drops were installed. The earnings of the company during the year were $28,860, and the expenses $12,065, leaving net earnings of $14,794—more than 20 per cent. on the capital invested. The net earnings were used largely in extending and improving the system, no dividends having been declared. Mr. Hill stated that the board of directors had decided to refund the $20,000 8 per cent. bonds now outstanding, and to replace these by an issue of 6 per cents.

WASHINGTON, D. C.—According to a circular of information issued by General Greely, Chief Signal Officer of the Army, the military telegraph now in operation in Cuba and Porto Rico transacts Government business free of charge. Commercial business is handled at a uniform local rate of two cents word, address and signature included. Messages of less than ten words are rated as ten-word messages. Where a message passes over a local line and then over a foreign line and again over a local line, two local rates will be charged. There are 53 telegraph offices in Cuba and 38 in Porto Rico. One of the offices in Porto Rico is communicated with by heliograph. Heliograph messages are charged an extra rate of two cents a word.

A COMBINATION OF MISSOURI HUMOR WITH BUSINESS.—On January 10 Messrs. Goodson and Wolfers, of Hopkins, Mo., opened a 50-telephone exchange, which is connected with the toll line system of the Hanamo Telephone Company, of Maryville, Mo. On this occasion a rather curious set of rules and regulations was posted for the guidance of the operators of the new concern. A correspondent has sent THE ELECTRICAL WORLD a copy of this example of humor, but does not say how the rules work in practice. These are the "rules and regulations":

"No agent shall be retained in the employ of this company who refuses to wear a lightning arrester on his or her conscience so as to immediately ground all spasmodic and wild currents emanating from other independent companies.

"This company will allow all agents to *dead-head* their individual business over the line when walking is crowded. Otherwise they must send it afoot.

"Any operator, male or female (female preferred), who fails to distinguish between a line drawn on business principles and a metallic line shall be electrocuted by a current from our new power generator.

"On and after January all business of the line shall be checked thrice daily before meals."

ELECTRIC LIGHT AND POWER.

DES MOINES, IA.—The Edison plant in this city has been improved by the addition of 1000 horse-power to its present generating plant.

TRENTON, N. J.—The electric light and gas companies of Englewood, N. J., have consolidated under the name of the Englewood Gas & Electric Company.

MUNCIE, IND.—The Muncie Electric Light Company has recently put into operation a 175-hp engine furnished by the Ball Engine Company, of Erie, Pa.

ROCHESTER, N. Y.—The Central-Hudson Railroad Company will introduce electric lights in its station here, and may install an electric plant of its own for the purpose.

ORANGE, N. J.—There is some talk of building a municipal electric light plant here. It is claimed that the city could save $20,000 a year by operating a plant of its own.

MOUNT VERNON, IND.—The electric light contract for this city has been let to William Gonnerman & Co. for a period of ten years, beginning July 28, 1899. The firm will install a new modern plant for arc and incandescent lighting, and will be pleased to receive printed information from manufacturers of central-station apparatus.

MOUNT JOY, PA.—Electric light in Mount Joy, both commercial and domestic, is supplied from the plant of F. E. Bailey & Co., at Manheim, Pa. The current is transmitted at 2000 volts over 7 miles of bare copper wire. Messrs. Bailey & Co. are using on the line regular double-petticoat, deep-groove insulators. They expect to supply a total of 600 lights in Mount Joy; the present load is about 300 lights. It may, however, be necessary to use a booster when running the 600 lights. They are running the same system for lighting the streets that they have in use in quite a number of other places of about the same size. One large transformer, located in the centre of the town, is used. It is connected for the three-wire system, using 115-volt, 3-watt lamps. This, the firm states, gives the very best results.

The Electric Railway.

SYRACUSE, N. Y.—The Syracuse, Baldwinsville & Lakeside Railroad Company is planning to immediately extend its track to Long Branch.

GREEN BAY, WIS.—The Fox River Street Railway has been sold to the reorganized company of old bondholders and stockholders, the price paid being $75,000.

HAMILTON, OHIO.—The Hamilton & Eaton Electric Street Railway Company has petitioned the County Commissioners for the right of way through this county, covering about 12 or 13 miles.

HARTFORD, CONN.—The directors of the Farmington & Torrington Electric Railway Company have decided to extend their road about 12 miles beyond Torrington to Bantam Lake. They will apply to the Legislature for the right to make this extension, which, it is estimated, will cost from $100,000 to $120,000.

WEBSTER, MASS.—The Worcester & Webster Street Railway Company has purchased a plot of ground in Oxford on which, it is stated, it will erect a new power house and car barn. The distance from Worcester to Webster is 17 miles, and Oxford is about half way between the two.

CHATTANOOGA, TENN.—Negotiations are pending for the purchase of the Chattanooga Electric Railroad by the promoters of the Chattanooga Rapid Transit Company, composed of Eastern capitalists. The Rapid Transit Company is operating an electric line to Rossville, Ga., and later the line will be extended to Chickamauga Park.

NEW BRUNSWICK, N. J.—The line of the Brunswick Traction Company, between this city and Somerville, was opened, amid some enthusiasm, on January 25. It is expected that through cars will be running between New Brunswick and Plainfield next summer.

RICHMOND, VA.—The Richmond Traction Company intends to increase its capital stock, and at a recent meeting of the stockholders the by-laws were so amended as to permit an increase from its present capitalization of $300,000 to double that amount. The charter of the company authorizes it to carry a capital of $1,000,000.

CHARLESTON, ILL.—The City Council has granted a franchise to the Charleston-Mattoon Electric Street Railway Company. The road will be in operation by November 1, 1899, and has a fifty-year franchise. It is provided that the City Council shall have the power to regulate the fare after thirty years. Till then a 5-cent fare will prevail.

GALION, OHIO.—A franchise has been granted by this city to Mr. W. E. Haycox, of Mansfield; F. C. Boyd and Willis M. Anthony, of New Haven, Conn., to build an electric railway from Bucyrus to this city and thence to Crestline. The road, it is expected, will be completed within a year, and it is likely that the power house and offices of the company will be located in this city.

LANSING, MICH.—The contracts for the construction of the Lansing, Dexter & Ann Arbor Electric Railway have been signed, and work will be commenced as soon as the weather will permit. The road will traverse one of the richest sections of the State, and will be 60 miles long. Eastern capitalists have taken the bond issue of $1,800,000, and have arranged with the Westinghouse Company to build and equip the road.

AKRON, OHIO.—The Akron, Bedford & Cleveland Electric Railway Company has secured the necessary consents to insure the construction of a branch line to Hudson. Private right of way has been secured throughout the entire distance, and it is expected that the road will be completed by May 1. A route from Hudson to Kent and Ravenna is now being surveyed, and it is thought that a road will be completed during the summer.

HACKENSACK, N. J.—The Union Traction Company, which operates eight miles of road between North Arlington and Carlstadt, was sold on January 27 by Receiver William M. Johnson to Mr. William Giles, of the Reorganization Committee. Mr. Giles' bid was $20,000 above the indebtedness, which is $852,000. The Metropolitan Traction Company foreclosed on the property. It is stated that the Union Traction Company intends to carry out its original plan of extending its tracks to Hackensack.

HUDSON, N. Y.—The Colonial Trust Company, of New York City, has purchased all the rights in the water power of Kinderhook Creek at Stuyvesant Falls for $125,000. The company is trustee for the Columbia & Renssalaer Railway & Lighting Company, which has purchased the Kinderhook & Hudson Railroad, the Nassau & Renssalaer and the Hudson Electric Railway. It is stated that a third-rail system will be laid down, and by the construction of 10 miles of additional track Hudson will be connected with Albany. Work will be commenced at once.

BOSTON, MASS.—A movement is on foot to unite all the street-car lines between Taunton, Mass., and Providence, R. I. The plan is for the Shore Syndicate, now controlling a line between Brockton and Taunton and one between Taunton and Providence, to assume control of the Taunton Street Railway, the Dighton, Somerset & Swansea Railway, the Globe Street Railway, of Fall River, and the Fall River & Newport Street Railway. This deal involves property to the value of $37,000,000, and if the plan is carried out it will be possible to ride from Brockton to Newport without change, and from Brockton to Providence.

ST. LOUIS, MO.—It is stated that the Union Depot systems of street railways has been sold to an Eastern syndicate, the deal being negotiated on the basis of $136.66 a share (par value, $100), or a total of $4,100,000. The syndicate is headed by Messrs. Brown Brothers, and, by this purchase, obtains control of 180 miles of surface lines in this city. It is believed that the Southern Electric and Hamilton systems will be absorbed by the syndicate. The traction franchise of Mr. McKee, of Pittsburg, has also been sold to Brown Brothers, which, it is stated, gives them possession of fully two-thirds of the street-car mileage of St. Louis.

HAVANA, CUBA.—The syndicate which controls the electric railways here desires to begin the work of changing the system over to electric power. The military authorities at first favored the underground system similar to that which is in operation at Washington and at New York, but this was decided to be impracticable owing to conditions which obtained in Havana during the tropical rains. It is stated that the authorities are now willing to permit the introduction of trolleys, but want the double overhead system. The company's representatives think that this is also impracticable, and want permission for the single overhead system. The matter is now under consideration.

ALBANY, N. Y.—Certificates of merger by the Nassau Electric Railroad Company, of Brooklyn, and the Atlantic Avenue Railway Company and the United Railroad Company, both street surface roads, were filed with the Secretary of State on January 26. The certificates are signed by John E. Borne, president, and William F. Ham, secretary, of the Nassau road. These gentlemen state that the Nassau Company has purchased all the capital stock of the two roads and that it has taken over all their real estate, property, rights, privileges and franchises. The capital stock of the Atlantic Avenue road was $2,000,000, and of the United Railroad Company $300,000. The merger is in accordance with the plan of the reorganization of the finances of the Kings County Traction Company and of the old Nassau Electric Railroad Company. The two merged roads are now a part of the system of the Nassau road, control of which was recently obtained by the Brooklyn Rapid Transit Company.

BALTIMORE, MD.—Negotiations which have been in progress for several weeks looking to the consolidation of all the street-car lines in and about Baltimore were closed on January 21, and a syndicate headed by Mr. Alexander Brown has turned over to the two companies upward of $6,000,000. The deal for the purchase of the Baltimore City Railway, which involves $12,500,000, was closed by the syndicate last month. The Consolidated Railway Company was acquired on January 21, the syndicate agreeing to pay $37.50 for its 366,880 shares, amounting to $13,758,000. The combined trackage of the two companies is more than 350 miles. It is stated that the syndicate will also engage in electric lighting. It has not yet decided whether to use its own plant for this purpose or absorb the existing three electric lighting companies, namely, the Brush Electric Company, the Edison Illuminating Company and the Northern Electric Company. The combined gross earnings of these properties amount to about $620,000 per annum, and the net earnings about $233,000. It is stated that the plan of financiering the United Railroads & Electric Company of Baltimore, which is the name of the corporation which is taking over the street railway properties, will be large enough to cover the cost of the three electric light companies, should it be decided to acquire control of these. The plant of the united company is ample to supply current for lighting, but it is thought that it will be more profitable to have all the electric companies under one management.

Legal Notes.

ALIGHTING FROM CARS.—Where a lady passenger of an electric car notified the conductor that she wishes to alight, and the car slows up on nearing the place, but starts suddenly when she is preparing to alight, recovery may be had for injuries resulting from being thrown to the pavement by the jerk. Springfield Electric Street Railway Company vs. Hoffner, Illinois Supreme Court, December 2, 1898.

RAILWAY MOTOR SUSPENSION CASE.—In the case of the Sprague Electric Railway & Motor Company v. the Camden & Suburban Railway Company, Judge Kirkpatrick in the United States Circuit Court, District of New Jersey, on November 7, 1898, decided that the defendant had infringed upon the claims of the Sprague patent No. 324,892. A perpetual injunction was ordered against the Camden & Suburban Railway Company against the use of the apparatus in question.

THE NASSAU ELECTRIC RAILROAD FINED FOR CONTEMPT.—On January 24 Judge Lacombe, in the United States Circuit Court, Eastern District of New York, ordered that the Nassau Electric Railroad Company (of Brooklyn Borough, New York City), be fined $25 per car for disobedience of the injunction against infringement of the Sprague patent (No. 324,892) covering a railway motor suspension. The complainant in this suit is the Sprague Electric Railway & Motor Company. The injunction, which was served on June 21, 1898, ordered the defendant to remove at least 250 of the suspensions within thirty days, 250 within sixty days, 250 within ninety days and the balance within 120 days. Judge Lacombe also granted an injunction in favor of the Sprague Electric Railway & Motor Company v. the Nassau Electric Railroad Company against the structures complained of in the first suit, under claims 2, 4 and 6 of the same patent. The injunction is granted under claims 2 and 6, but not under claim 4 (which has not yet been adjudicated) against the present wood-block, bolt and nut device (nose suspension). The order requires that the first 250 shall be removed after sixty days, and thereafter at the rate of 300 a month until all are removed.

FUNDAMENTAL PATENT ON CAST-WELD JOINTS OVERTHROWN.—The United States Circuit Court at St. Louis has filed an opinion in the case of the Falk Manufacturing Company vs. the Missouri Railroad Company and the American Improved Rail Joint Company, of Chicago. This is an infringement suit brought by the Falk Manufacturing Company on patent No. 545,040, issued to Albert H. Hoffman and Herman W. Falk, August 20, 1895. The patent is a fundamental one on cast-welded joints, the first claim reading as follows: "An improved method of forming rail joints, consisting in cleaning the rail ends to be joined, forming or adjusting a mold upon said rail ends and over the joint so as to surround the webs and base flanges thereof, heating said mold and said rail ends, and pouring molten metal into said mold and around and beneath the base flanges of both rails, and uniting said metal directly to the surfaces of said rail ends by fusion." The defendants' argument, which the opinion confirmed, was that every step in the process is something that was known in the general art of casting and founding long before the application for the patent in suit was made. The efforts of the patentee, as disclosed by this patent, belong to the domain of mechanical skill and not to the domain of invention. The complainant's patent was

clearly anticipated by previous English patents, one issued in 1851 and another of still greater antiquity being issued to the famous George Stephenson as far back as 1831, in which the opinion states that everything set forth in the Falk patent in the way of doing cast welding was well known.

EDUCATIONAL NOTES.

THE COLUMBIA UNIVERSITY CATALOGUE for 1898-99 is a voluminous affair, containing no less than 436 pages. It gives a great deal of information regarding the work of this university.

TELEPHONE DISTURBANCES.—Mr. J. J. Carty, engineer of the New York Telephone Company, New York, on January 24 delivered a lecture before the College of Engineering of the University of Minnesota, Minneapolis, Minn., on the subject of "Telephone Disturbances." The sources of disturbances upon telephone lines were discussed in an able and interesting manner, with the aid of numerous diagrams. The next lecture of the course will be by Mr. Truman Hibbard, on "Transmission of Power from Waterfalls."

THE UNIVERSITY OF WISCONSIN.—The biennial report of the regents of the University of Wisconsin for the years 1896, 1897 and 1898 makes special reference to the college of engineering, and calls attention to the fact that the graduates of this college have readily found important positions, and that many of them have now responsible places in some of the largest industrial establishments in the United States. The report points out some of the special requirements of the institution, which is in need of apparatus. The necessities of the college of engineering are referred to. The steam laboratory is so crowded that it is almost dangerous for an inexperienced person to pass through it when the machinery is in operation. The erection of a new building for the College of Engineering is recommended.

PERSONAL NOTES.

MR. E. G. BUCKWELL has been engaged to take charge of the sales department of the Cleveland Twist Drill Company, Cleveland, Ohio.

COLONEL EUGENE GRIFFIN has been nominated by the President to be Brigadier-General of Volunteers. The nomination was sent to the Senate on January 23.

MR. DAVID GREENE, treasurer of the Case Manufacturing Company, Columbus, Ohio, died in New York City on January 14. Mr. Greene was born in 1867, and was held in high esteem by all who knew him. A widow and two children survive the deceased.

MR. W. N. MATTHEWS has severed his connection with the St. Louis Electrical Supply Company, of St. Louis, Mo., as president and treasurer, and will be succeeded by Mr. Russell Stanhope. Mr. George S. McLaren will succeed Mr. Stanhope as vice-president and secretary of the company.

MR. JOHN McGHIE.—Published accounts of the work of the General Electric Company in the last few years, both in the advertising and text pages, have been in charge of Mr. John McGhie, who has been at the head of the company's advertising department. On January 31 Mr. McGhie's connection with the company ceased, his future work being in Cleveland, Ohio, where he will represent the "American Machinist." Through his long connection with the General Electric Company Mr. McGhie is well known to the electrical fraternity. Born in 1865 in Liverpool, Mr. McGhie was educated in that city and at the University College, London. His first literary work was as secretary of the "Westminster Review" in London. Coming to this country in the year 1890, his earliest connection with the electrical business was with the Edison General Electric Company, his first position being as assistant to the manager of the Bergmann works. Three years later, after the consolidation of the General Electric, he was put in charge of the advertising department, which position he has held until the present time. Mr. McGhie may be said to have invented the reading notice, which is now so prominent in the columns of the technical press.

OBITUARY NOTE.

MR. A. B. JOHNSON, father of Mr. Edward H. Johnson, vice-president and general manager of the Sprague Electric Company, New York, was killed in Greenwich, Conn., in a carriage accident on January 29. Mr. Johnson was over seventy years of age. He was driving from his home to the village when the carriage was overturned in some manner, resulting in fatal injuries to the aged gentleman. The many friends of Mr. E. H. Johnson sympathize with him in the untimely death of his father.

Trade and Industrial Notes.

CHANGE OF FIRM NAME.—The Armington & Sims Company, of Providence, R. I., has changed its style to the Eastern Engine Company.

THE LISTIE MINING & MANUFACTURING COMPANY, Somerset, Pa., is installing an electric mining outfit. The power will be furnished by a 175-hp engine built by the Ball Engine Company, of Erie, Pa.

SWITCH CATALOGUES WANTED.—Messrs. Williamson & Joseph, Limited, Northampton Grove, Canonbury, London, England, desire to secure copies of switch catalogues from manufacturers of this class of apparatus.

MESSRS. LERCH BROTHERS, Baltimore, Md., recently started up a direct-connected outfit in their store consisting of a General Electric generator direct-connected to a 100-hp engine built by the Ball Engine Company, Erie, Pa.

BALL-BEARING PAY-OUT REEL.—The Western Electric Company has issued a bulletin briefly describing and illustrating the Dicke ball-bearing pay-out reel, which was described and illustrated in THE ELECTRICAL WORLD of January 7, 1899.

THE ASHTON VALVE COMPANY, 271 Franklin Street, Boston, Mass., is out with a calendar for 1899. The illustration on the card is quite unique, and represents two children, one playing with a toy locomotive and the other with a toy steamboat.

BRIDGES FOR HAWAII.—The Berlin Iron Bridge Company, East Berlin, Conn., has just shipped several carloads of bridge material to the Hawaiian Islands, and men will be sent from the United States to put the bridge in place. It is believed that this is the first bridge from the United States that was ever put up in these islands.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, reports a very flattering trade in standard elevator buckets and spiral conveyors. This company has recently taken up the manufacture of this apparatus. Anyone interested in this particular line will do well to secure a copy of the Jeffrey company's latest catalogue, which will be sent on application.

ELECTRICITY AT THE INDIAN HEAD PROVING GROUNDS.—It is stated that the Westinghouse Electric & Manufacturing Company has received an order from the United States Government for electrical apparatus to be used at the Indian Head proving grounds. Two double-current generators will be installed, the alternating current being used for lighting the powder plant and the direct current for the operation of a button-contact railway about the grounds.

THE LACLEDE BATTERY COMPANY, of Kokomo, Ind., is distributing a very artistic calendar for 1899, which will be particularly appreciated by those who get a copy, because its artistic merits are not spoiled by surrounding advertising matter. In this instance the art feature is predominant. It consists of a handsome etching, entitled "Stacking Time," set in a heavy cardboard mat. A small monthly calendar is pinned to the mat, and the only advertising matter are the words, "Compliments of Laclede Battery Company, Kokomo, Ind.," in modest letters on one corner of the card.

MESSRS. J. HOLT GATES & CO., Marquette Building, Chicago, report the following recent sales: Armour & Co., Union Stock Yards, Chicago, one 800-kw, two 500-kw Walker generators, and one 7000-light and two 3600-light Warren single-phase inductor alternators, 1100 volts and 7200 alternations; one 75-kw Warren alternator, 1100 volts and 1100 alternations, to the Marion, Ill., Electric Light Company; one 60-kw Warren inductor-alternator to the Rossville Canning Company; one 50-kw Wagner multipolar dynamo to the Jefferson Electric Company, Chicago; one 200-kw Card 220-volt generator to the Davenport, Iowa, Gas Company; one 150-light, 2000-cp Excelsior arc machine to the Burlington, Iowa, Street Railway.

MESSRS. PARTRICK, CARTER & WILKINS, 125 South Second Street, Philadelphia, Pa., are out with their 1899 catalogue of electrical house goods. It contains eighty pages, and covers a wide range of electrical apparatus for household use. The firm's leading product—the patent needle annunciator—is given prominent attention in the catalogue, the various illustrations of this device being excellently executed. Among the articles listed and illustrated may be mentioned, besides annunciators of all classes and sizes, bells in a great variety of styles and sizes, magnetos, push buttons of all kinds, from the ordinary wooden affair to the elegant bronze production; gas-lighting burners, battery switches, watchmen's clocks, batteries, etc., etc. This firm's business was established in 1867.

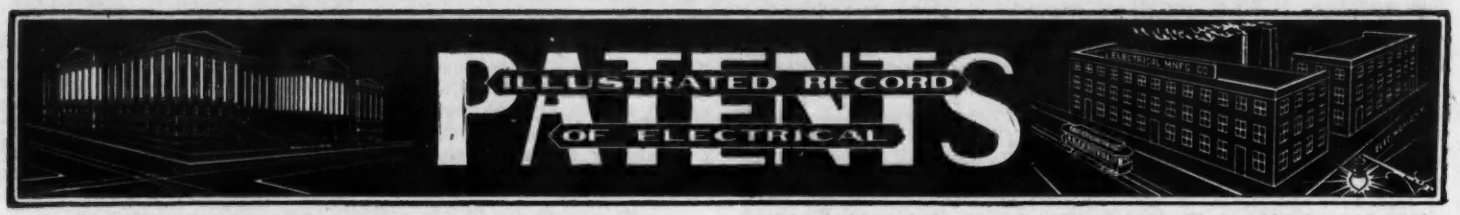
THE CHICAGO BOILER-CLEANER COMPANY, 828 Monadnock Block, Chicago, Ill., was recently called upon to remove the scale from three water-tube boilers in the Union Station at Columbus, Ohio, after several other companies had failed in the attempt to accomplish the purpose. It successfully performed the task by adapting the power-driven cleaner to this particular case, and succeeded in thoroughly removing the scale and leaving the tubes brighter and cleaner than when new. The engineer of the Union Depot Company at Columbus expressed his high appreciation of the work and the satisfactory manner in which it had been done. Besides the power-driven apparatus above referred to, this company manufactures turbine cleaners driven by water pressure, combined hand scrapers and blowers, Phœnix automatic smoke consumers, etc.

THE UNITED STATES ELECTRO-GALVANIZING COMPANY, 346 Broadway, New York, two years ago introduced a new process of galvanizing by electrolysis. Its New York plant has a capacity of about two tons per day, and galvanizes any kind of jobbing work. A great variety of articles can be galvanized by this process, namely, screws, cutting instruments, tools of every description, springs, locks, etc. Screws and threads need no recutting after being galvanized, and springs preserve their elasticity and temper. It is stated that a considerable reduction in cost of operating is effected, 80 to 90 per cent. of spelter being saved, besides the economy in fuel. There is no dross, which, in the old process of zincing by heat, consumes from 30 to 50 per cent. of zinc. Electrolytic galvanizing is particularly adapted to articles consisting of two or more movable parts, such as pulley blocks, gauge tools, etc., since the parts are not soldered together by the galvanic process.

"CALENDAR OF MASTERPIECES."—The artistic tendencies in calendar making for the last few years have been very pronounced and each succeeding year has developed in this line a higher degree of art than ever before attempted. Many of this year's productions posses real artistic merit, but the finest of them all is, without doubt, the calendar gotten up by the J. G. Brill Company, of Philadelphia, Pa. This elegant work is made up of ten sheets of heavy paper, 18 by 22 inches in size, and tied together at the top with a gray satin ribbon. On the first sheet is the title, "Calendar of Masterpieces, with the story of the pictures by Prof. H. Ward Rhodes, Museum of Fine Arts, Washington University." The next six sheets contain monotint reproductions of celebrated paintings, the titles of which are "Neighbors," "Adagio," "Phœbe," "The Dancing Lesson," "Marianna," and "Consolation in Sorrow." The tint of each picture differs from that of the others. The sheets following give the stories of the pictures, printed in a light olive green tint and adorned with illuminated border and initial letters. The illustrations measure about 10 by 13 inches and represent the highest development of the art. Although this elegant work is called a calendar, the real calendar is a comparatively insignificant affair, and is entirely subordinated to the ar-

tistic features of what might be called the "masterpiece calendar." The J. G. Brill Company has made a happy combination of enterprise and art in this beautiful calendar.

AN IMPROVED ELECTRIC CIGAR LIGHTER.—Messrs. Stanley & Patterson, 32 Frankfort Street, New York, are placing upon the market an electric cigar lighter which possesses several commendable features. The torch is ignited by simply withdrawing it from its receptacle. In construction it consists of a short length of metallic tubing, the lower end of which is open, the upper end projecting into a small reservoir, which serves as well as the handle of the torch. Packed in this reservoir and passing through the tube is an asbestos wick, which is saturated with alcohol or any other volatile fluid. As the lower end of the wick projects slightly below the end of the tube, the vapor given off at this point becomes ignited by a spark, which is produced by drawing the torch out of its receptacle. The tube passes between two short, horizontal arms, which constitute the terminals of the circuit, and as the lower end of the tube is expanded the circuit is closed by the enlargement of the tube coming into contact with the two terminals in the act of withdrawing the torch. The circuit being immediately broken, a spark is produced in the usual manner, and the vapor given out at the end of the torch is ignited. This torch may be used on either electric light or battery circuits. When used on regular electric light circuits the "lighter" is provided with an attachment plug. Two cells of dry battery are used when operating with battery current. The "Matchless Electric Lighter," as it is called, is made of fine white china, and is of artistic design. It is made in two styles, viz., wall bracket form, and portable form, for use on tables, stands, etc. It is stated that the cost of maintenance is exceedingly low.

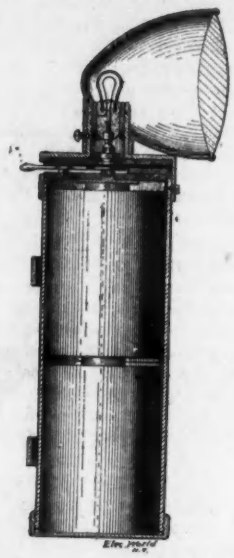


UNITED STATES PATENTS, ISSUED JANUARY 24, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

618,054. TRAIN TRACTION SYSTEM; F. E. Case, of Schenectady, N. Y. App. filed June 22, 1898. The combination of a controlling device having external terminals, and a connection board with which terminals register.

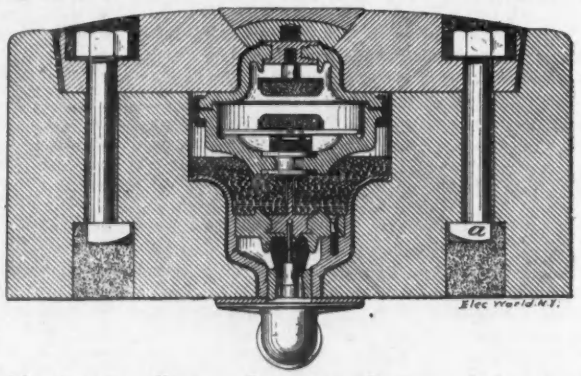
618,057. SECONDARY BATTERY AND ELECTRIC LAMP; W. A. Crowdus, of Chicago, Ill. App. filed Nov. 22, 1897. In a secondary battery the combination of a cylindrical lead-containing cell, having its inner surface provided or coated with an active material forming one element, and a laterally perforated centrally located tubular opposing element of the battery open at the top and closed at the bottom to form a central well for the purpose of supplying liquid to the battery, substantially as described.



No. 618,057.—Secondary Battery and Electric Lamp.

618,071. MOTOR SPEED CONTROLLER; C. A. Dresser, of Chicago. Ill. App. filed July 28, 1898. The combination with a solenoid and the core thereof of a variable rheostat having the movable element thereof connected with said core, a switch for energizing said solenoid to move the core thereof; a lock for holding said core in any position to which the same is moved; a releasing magnet for releasing said lock and a switch for controlling the circuit through said releasing magnet,

618,131. BEARING FOR ARMATURE SHAFTS OF ELECTRIC MOTORS; H. L. Parker and C. R. Meston, of St. Louis, Mo. App. filed July 9, 1898. The combination with a suitable frame for supporting an annular laminated field-magnet core, of a fixed shaft in said frame, a sleeve mounted on said shaft, and a laminated armature core mounted on said sleeve.



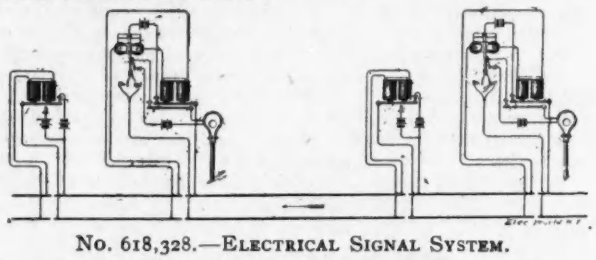
No. 618,179.—Circuit Closer for Electric Railways.

618,137. SIGNAL FOR TELEPHONE SWITCHBOARDS; Chas. S. Scribner, of Chicago, Ill. App. filed Dec. 8, 1896. The combination with a telephone line and means for producing current in the line while the telephone is in use, of a relay magnet in the line, a local circuit including a supervisory signal, a normally open shunt about the signal controlled by the contact points of the said relay, and a magnet winding of the relay included in the shunt, substantially as described.

618,144. ELECTRICAL SELECTIVE APPARATUS; J. S. Thompson, of Chicago, Ill. App. filed Oct. 10, 1898. The combination with a transmitting circuit, and with means for developing therein currents of different predetermined sizes or strengths, of a series of electric magnetic devices which are constructed so as to be actuated by successively smaller currents, and also so as to require successively greater periods of time for actuation, and which are connected in parallel in the transmitting circuit; and means whereby, upon the actuation of any one of such devices, the relatively slower ones are in effect cut out of circuit.

618,162. MAGNETIC CLOSER FOR ELECTRIC RAILWAYS; W. M. Brown, of Johnstown, Pa. App. filed Aug. 27, 1898. A magnetic closer comprising the combination of a plurality of cores and energizing coils for the same, a single continuous metallic pole-piece provided with perforations and coated throughout with enamel connecting said cores; a series of disconnected metallic plates and bolts passing through said perforations and securing said plates against the underside of the coated pole-piece.

618,163. ELECTRIC-MOTOR CONTROL; W. M. Brown, of Johnstown, Pa. App. filed Oct. 7, 1898. The method of accelerating a plurality of motors consisting in changing the circuit relations between the said motors, and during the period at which the motors are in a given circuit relation with each other decreasing the field strength and ohmic resistance of first one motor and then another motor.



No. 618,328.—Electrical Signal System.

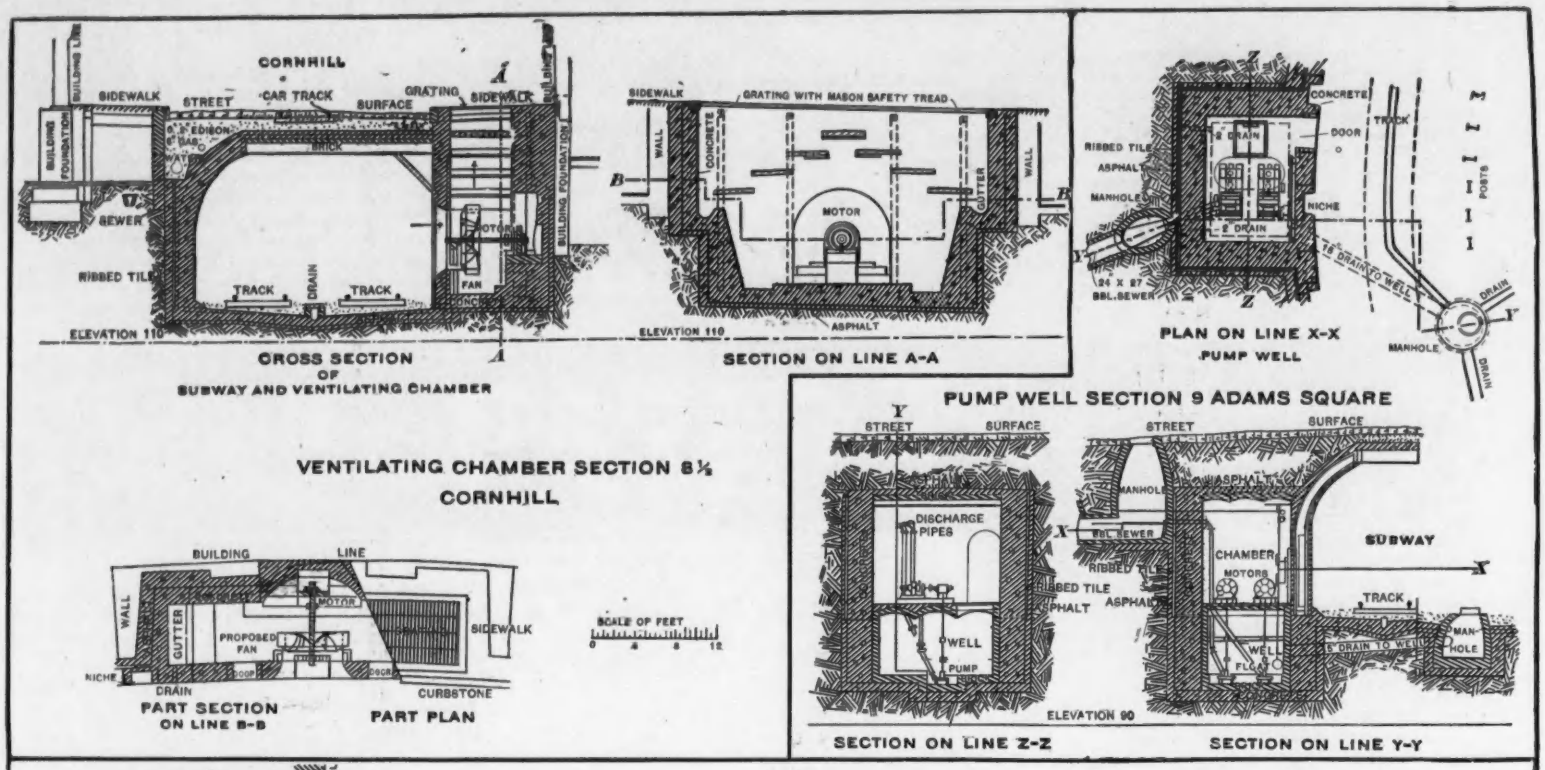
618,175. AUTOMATIC SWITCH FOR DISTRIBUTION OF ELECTRICITY; J. Hopkinson, of London, Eng. App. filed April 18, 1895. An automatic switch provided with a two-part movable, rigid brush having its two parts independently pivoted to equally distribute the contact pressure among four contact surfaces.

618,179. CIRCUIT CLOSER FOR ELECTRIC RAILWAYS; G. H. McFeaters, of Johnstown, Pa. App. filed Oct. 10, 1898. The combination, in an electric contact box, of the cover, having two sides of magnetizable material separated by a non-magnetizable centre, a stationary carbon contact in connection with said top and below the same, a transversely disposed armature below said cover, connections thereto from the source of supply, and a second carbon contact secured to said transversely disposed armature.

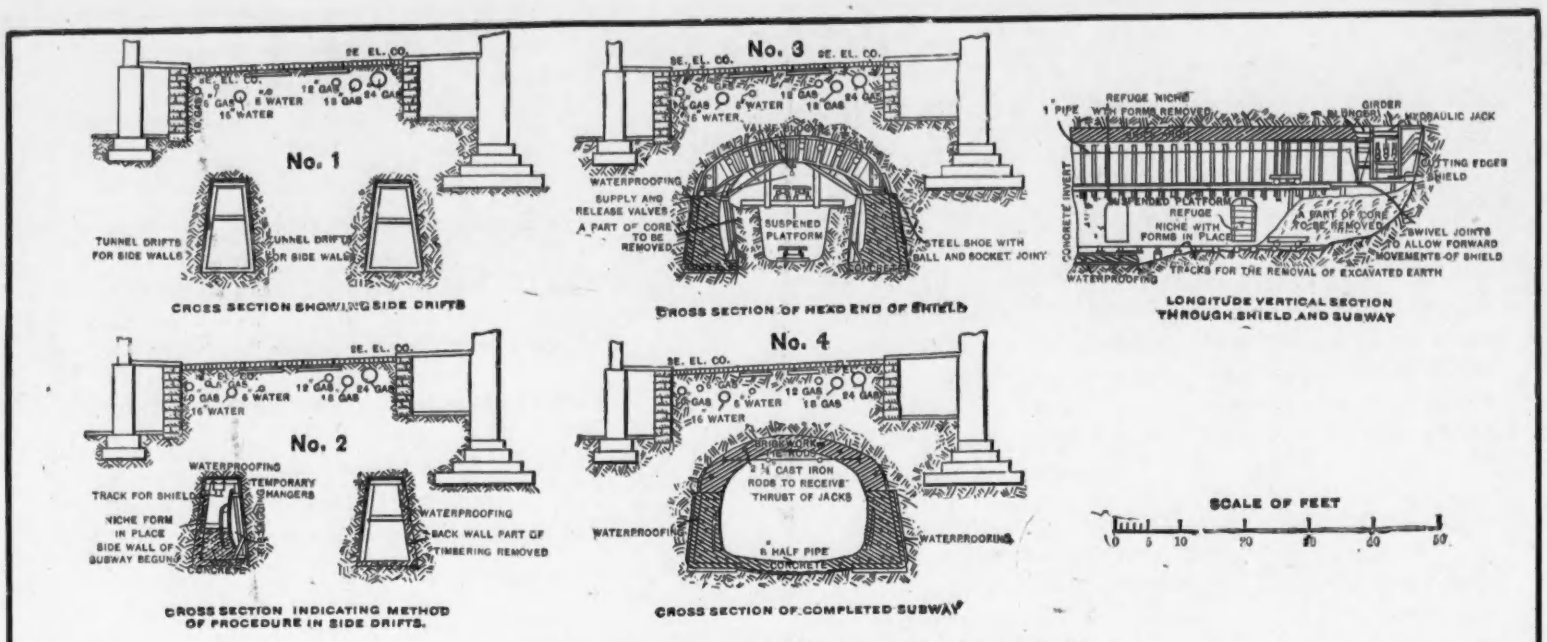
618,231. TROLLEY STAND; D. Moyer, of Allentown, Pa. App. filed April 12, 1898. In a trolley stand, the combination with a pivoted pole-socket provided with a lever, projections from the opposite faces of said lever, pivoted arms upon opposite sides of said lever, a frame, and springs extending between said arms and the opposite ends of said frame to exert tension upon the arms in opposite directions, substantially as described.

618,328. ELECTRICAL SIGNAL SYSTEM; J. P. Buchanan, of Boston, Mass. App. filed June 10, 1893. The combination of a track circuit including a polarized translating device, a neutral translating device and a current reverser; a signal controlled by said circuit; means for operating the current reverser, and another circuit controlling another signal and operated by the circuit including said translating devices.

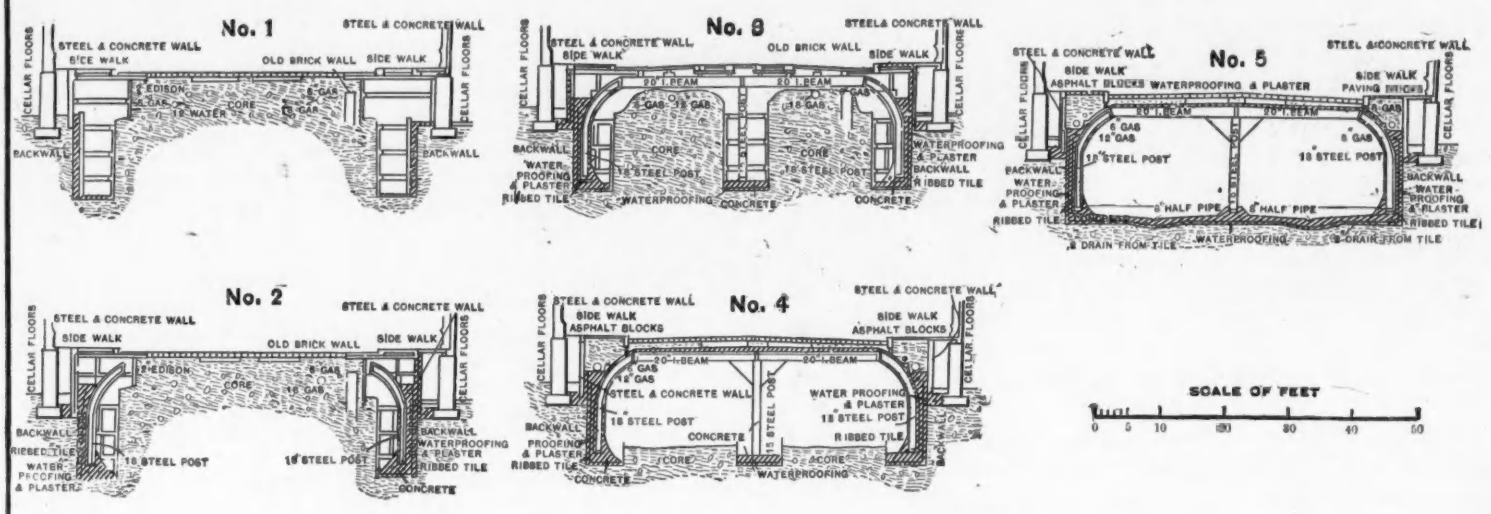
618,380. ELECTRIC SWITCH; W. J. Ferguson, of Baltimore, Md. App. filed Feb. 2, 1898. An electric switch having in combination a case with a stationary circular chamber; the terminals of an electric circuit exposed in said chamber; a segment-shaped non-conducting plate in the chamber pivoted so as to turn therein like a rotary key, and mercury in said stationary chamber which shall be shifted by turning said segment-shaped plate.



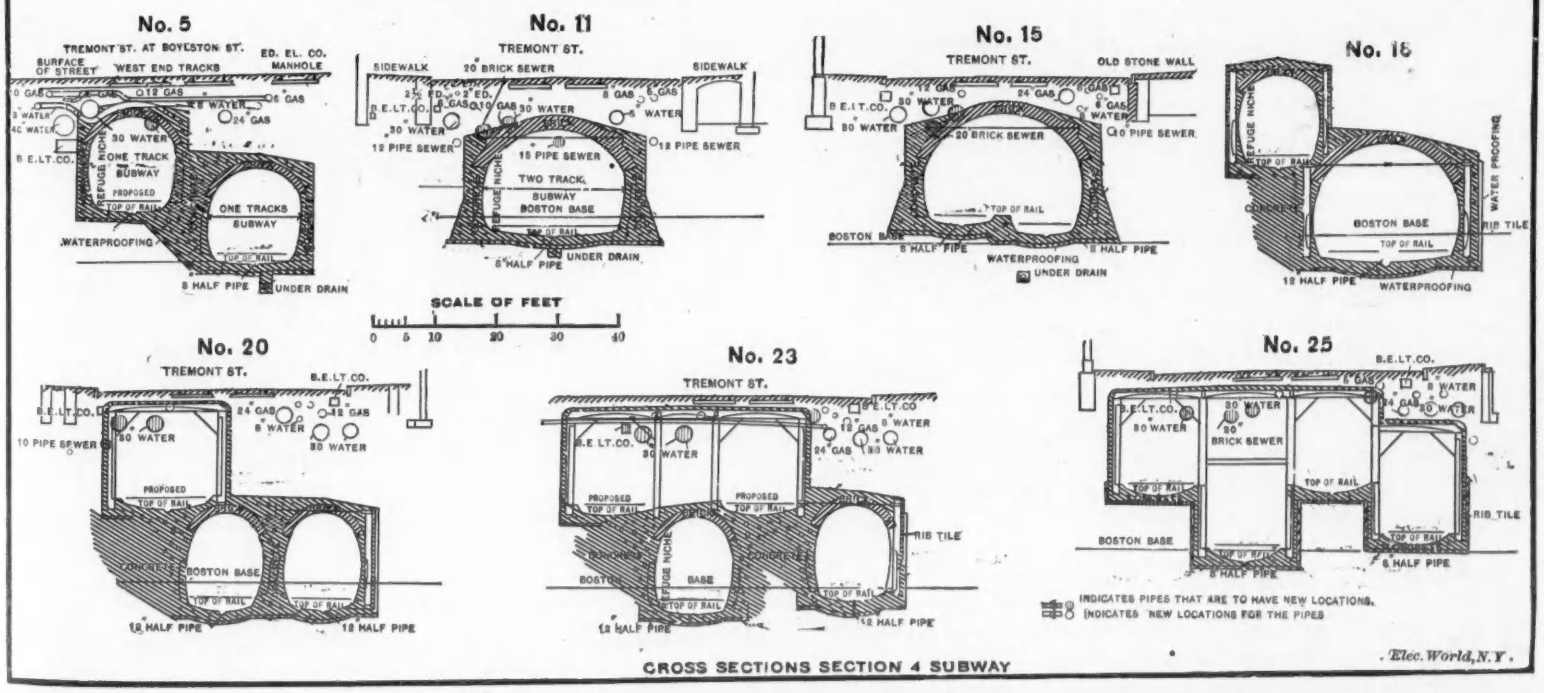
DETAILS OF THE CONSTRUCTION OF THE BOSTON SUBWAY.


No. 1
No. 2
No. 3
No. 4
SE. EL. CO.
16 WATER
TUNNEL DRIFTS FOR SIDE WALLS
CROSS SECTION SHOWING SIDE DRIFTS
WATERPROOFING
SUPPLY AND RELEASE VALVES
A PART OF CORE TO BE REMOVED
SUSPENED PLATFORM
STEEL SHOE WITH BALL AND SOCKET JOINT
CROSS SECTION OF HEAD END OF SHIELD
REFUGE NICHE WITH FORMS REMOVED
GIRDER
HYDRAULIC JACK
CONCRETE INVERT
SUSPENDED PLATFORM
REFUGE NICHE WITH FORMS IN PLACE
A PART OF CORE TO BE REMOVED
SWIVEL JOINTS TO ALLOW FORWARD MOVEMENTS OF SHIELD
TRACKS FOR THE REMOVAL OF EXCAVATED EARTH
LONGITUDE VERTICAL SECTION THROUGH SHIELD AND SUBWAY
TRACK FOR SHIELD
TEMPORARY MANGERS
NICHE FORM IN PLACE
SIDE WALL OF SUBWAY BEGUN
WATERPROOFING
BACK WALL PART OF TIMBERING REMOVED
CROSS SECTION INDICATING METHOD OF PROCEDURE IN SIDE DRIFTS.
2 ¼ CAST IRON RODS TO RECEIVE THRUST OF JACKS
8 HALF PIPE CONCRETE
CROSS SECTION OF COMPLETED SUBWAY
SCALE OF FEET
0 5 10 20 30 40 50

TYPICAL CROSS SECTIONS OF THE SUBWAY SECTION 6 TREMONT ST.
SHOWING DIFFERENT STAGES IN THE PROGRESS OF THE WORK.



TYPICAL CROSS SECTIONS OF THE SUBWAY SECTION 10 WASHINGTON ST.
SHOWING DIFFERENT STAGES IN THE PROGRESS OF THE WORK.



CROSS SECTIONS SECTION 4 SUBWAY

Elec. World, N.Y.